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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Improvement of the Ohio River.—Explanatory Remarks on the "Review" of Ellwood Morris, Esq., C. E. By W. Milnor Roberts, C. E.

The Review repeats most of the statements and reasonings heretofore advanced by the friends of the Reservoir System, and offers some additional facts and remarks in its favor, while criticising the Lock and Dam System. It is rather less acrimonious towards the latter plan than were former papers.

Concerning Reservoirs.

In considering the plan of feeding the river from artificial reservoirs, the chief points, are :—

1. The annual depth of rain-fall. 2. The proportion of rain-fall that may be safely relied upon. 3. Capacity of reservoir sites relatively to the height of the dams, respectively, and the loss from evaporation from the reservoirs, and from flowing one hundred, two hundred, or more miles, between the reservoirs and Pittsburgh. 4. The cost of construction and management. 5. The practicability of establishing a sufficient number of reservoirs to produce the proposed flow of 6 feet in the Ohio River during the dry season.

1. All seem to concur in assuming about 36 inches as the probable annual rain-fall at the heads of the Ohio.

2. The proportion that may be utilized or made practically available, is claimed by Mr. Morris at nearly 50 per cent. of the downfall. Mr.

Ellet, from careful measurements and calculations based on the *entire flow* of the river at Wheeling, found an average, through a series of years, of 40 per cent.; but in one year it was but 27 per cent., and for two successive years it was under 30 per cent. Had any large share of this been stored up in reservoirs, and allowed to flow only during the months of greatest evaporation, would not the quantity passing Wheeling have been reduced? Mr. Morris furnishes a table which includes several reservoirs operated by Messrs. Morris and Smith, presenting an average of 50 per cent. gathered, and giving also the writer's estimate of the quantity flowing from the West Fork Reservoir, which was 40 per cent. But in that case, the pipes connected directly with the canal supplied, and the per centage named covered the entire *leakage* of the reservoir, which was used by mills. If we take the reservoirs surveyed by Mr. Morris, draw out the water only in droughts, and permit it to flow exposed to the sun for two hundred miles, would not a considerable proportion of the quantity originally gathered be lost? The proportion utilized in *Great Britain*, as instanced by Mr. Morris, must of necessity be larger than in this country, on account of the greater *moisture*, and the lower range of temperature, especially during the period of greatest evaporation. We all know that in our climate, during hot weather, rains occur which add no appreciable quantity to the volume of American streams or reservoirs; although measurable in the gauge. The writer expressed the opinion that from 33⅓ to 40 per cent., in different locations, was enough to allow for the quantity to be gathered; and that it was prudent to allow only about 33⅓ per cent. to be utilized as feed water for the Ohio.

3. Respecting the capacity of Reservoirs: Mr. Morris thinks it is entirely safe to assume that those proposed on the heads of the Ohio, will present a mean depth of at least 50 per cent. of the greatest *water rise* at the dams. He adduces *four* reservoirs, surveyed by himself, which show an average mean depth of but 39⅓ per cent.; the greatest being 46, and the least 27½ per cent. The writer claims, that the mean depth will on an average be nearer a *third* than *half* of the greatest water rise. The mode of calculation adopted by the engineers in arriving at the probable or approximate contents of certain reservoirs quoted, is unknown to the writer. Something depends upon this.

But, at last, this is not the *vital* point. The great object is to secure the largest *quantity of water* for a given height of dam. The future will show who is most at fault in the consideration of this part of the subject.

4. In regard to estimates of cost of the Artificial Reservoirs: the writer instanced a reservoir, previously referred to by Mr. Morris, the Conemaugh Reservoir, which is claimed by all connected with its survey and location, to be a favorable site, and it is in the very region in question. Allowing but *half* the cost of this reservoir as a gauge for an average, it showed a total of over $27,000,000 for the reservoirs. Others will judge how far this mere statement of a fact should influence their judgments in regard to the probable ultimate cost of the Reservoir System. The cost of managing, and repairing, and regulating the flow, &c., will depend very much upon the kind of system; whether numerous small

reservoirs, or comparatively few large reservoirs. Mr. Morris has given an estimate, which appears to the writer to be small. It is a question which can scarcely be definitively settled in this stage of the investigation.

5. The practicability of establishing such a reservoir system as that proposed by Mr. Ellet and Mr. Morris, in the region designated, is a cardinal point. Have its advocates proved it to be reasonably practicable? Although the writer coincides with Mr. Morris in the opinion that many reservoirs are healthy, and not injurious to the country in their vicinity, that does not prove that all reservoirs, under all circumstances, will be so; or that the people immediately interested will so regard them. Something in this respect depends upon the locality, and upon the manner of drawing off the water from different reservoirs.

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Relating to Low Open Dams.

It is now understood, that in suggesting and considering a modification of Mr. Haupt's plan, it does not follow that the writer must stand forth as the supporter of that plan in opposition to the system of locks and dams, the only plan he has advocated; and especially when he distinctly announced, that it was only submitted *for consideration* as an adjunct to the Reservoir System, as a means of saving water, and thus reducing the number of reservoirs.

In October last, when Mr. Ellet called the writer's attention to "errors" in connexion with that branch of the discussion, he, as well as Mr. Morris, was under a misapprehension respecting a part of the premises of the writer. If, hereafter, by experiment or otherwise, it should appear that the proportion of water to be saved will not warrant the erection of low open dams in connexion with the Reservoir System, they will of course be entirely discarded, as they are in no way associated with the system of Locks and Dams.

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Relating to Locks and Dams.

The main features connected with Locks and Dams, are: 1. Supply of water. 2. Cost of construction and management.

1. In the Review, Mr. Morris, when considering the supply of water, in taking the extreme of the lowest water measurements as given by him, for the Monongahela, 4500 cubic feet, and for the Allegheny, 80,000 cubic feet, establishes the following results: that at the period of lowest water the Ohio River contains *nineteen* times the volume of the Monongahela; whereas, the writer, basing his calculations on a low water measurement made by himself on the Monongahela, and reported to him by Major Saunders, on the Allegheny, assumed that the volume of the Ohio was but *thirteen* times that of the Monongahela. Mr. Ellet's calculation of the low water flow at Wheeling (1 foot depth,) gave 102,000,000 cubic feet per minute, or about a fourth more than the minimum introduced by Mr. Morris. But even taking this (84,500 cubic feet,) the extreme lowest assumption, Mr. Morris clearly *proves* that there is water enough without reservoirs. In order to use up this *mini-*

mum flow of the very driest period, he presents a much larger size of double locks, each 420 by 80 feet in the chamber; adds 2 feet to the assigned lift of 8 feet, making 10 feet lift, and empties both of the large double locks every *six minutes!* Whereas, the writer's proposition was, locks 350×65 feet chambers, 8 feet lift, and an allowance of 12 *minutes** for the passage at each lock. Mr. Morris also assumed that 20,000 cubic feet per minute, or 28,800,000 cubic feet per day, will *leak* through a dam and 2 locks. Then his statement stands thus,

Lockages per day, 420×80×10×2×240 . .	= 161,280,000
Daily low water flow of the Ohio, 64,500×60×24	= 92,880,000
Daily deficiency in low water to be supplied by reservoirs!	68,400,000

Now correcting this, even using the same enormous dimensions of lock chambers, the case will be thus:

Lockages per day, 420×80×8×2×120 .	= 64,512,000
Daily flow as assumed by Mr. Morris, . .	= 92,880,000
Daily surplus! . .	28,368,000

Hence, the "Review" fortifies the Lock and Dam system on the vital point of water supply, and will assist in making converts to the opinion that *no artificial reservoirs can be necessary for the slackwater plan.* Before leaving this point, let us glance for a moment at the amount of business that could be passed, allowing but 500 tons for each lockage, and 12 minutes for the time, and 350 days in the year! It is (42,000,000,) *forty-two millions of tons!*

On Mr. Morris's data, it would have been just *double*, or *eighty-four millions of tons!* And this is placed in juxtaposition with the extreme low water period; being always the dullest season of the year. The writer would suggest, that *one-fourth* even of this last tonnage is an enormous amount of trade, much more than sufficient for the argument.

2. *Cost of construction and management.*—Mr. Morris, falling back upon Mr. Ellet's estimate, continues to assume the first cost of the locks and dams at $25,000,000, or more than double that of the writer. This question has already been discussed in some detail: the writer is satisfied to let the estimates remain for future final investigation before an impartial competent umpire.

The cost given by Mr. Morris for the Monongahela improvement, covers not only the first cost, but also, all expenses of superintendence, management, repairs ordinary and extraordinary, damages to lands, damages of floods, and renewals, *through a period of eighteen years that the works have been in operation!* These items alone at the rate of $110,000 per annum for 18 years would amount to $1,980,000 on the Ohio improvement, by the writer's estimate.

* In one place in the main article of the writer, a calculation is given merely showing how much water would be used in passing boats every five minutes, with locks 360×60 feet, but in the above connexion, the size of the locks was 350×65 feet, and the time allowed for passing the lock 12 minutes!

The cost of superintending and keeping in repair a thoroughly constructed steamboat navigation, without other works than the locks and dams, cannot, in reason, be compared with the cost of maintaining a mixed canal and slackwater like that of the Schuylkill Navigation; especially when it is considered that the average fall on the Ohio is only *six inches* per mile, while on the Schuylkill it is about *six feet*, or twelve times as much per mile!

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Additional Rise of Floods.

There is one other point, of some importance in this discussion, in relation to which the writer is of opinion that Mr. Morris's own premises and reasoning lead to the same general result claimed by the writer. In considering the *additional rise* to be caused by high floods in consequence of the proposed dams, Mr. Morris presses the theory that all floods will be augmented to the full extent of the height of water already in the river. His conclusion on the point is in these words: "Now this underline or inclined plane of a sixteen feet freshet, being once formed 5 feet higher in consequence of the dams, would bear up all superimposed water, and would of course produce *at least the same extra elevation in all higher freshets.*" Observe, with a 21 feet freshet in the natural river,* Mr. Morris assumes that it "would create a 16 feet freshet in the pools of the dams, and would actually form an inclined plane over the dam;" and that "the surface line *is actually higher* than it would have been in the unobstructed river, *by precisely the proposed minimum low water depth to be added to the pools, or five feet.*"

That is, the same flood, 50 feet deep in the natural river, when it comes upon a part of the river already raised 5 feet, will be 55 feet deep. But is not this a physical impossibility, on a river of equal descent, which is assumed by Mr. Ellet and Mr. Morris, to *widen rapidly* with each foot of increased depth? If the 5 feet referred to, were *solid rock*, there would not be quite 50 feet depth of water, *on account of the increased width* of the valley flowed. But instead of rock, it is *moving water*, to which augmented motion is communicated by the greater velocity of the flood, the whole flowing faster on account of the real increased depth, although that increased depth would be less than 5 feet. Pursue Mr. Morris's theory in connexion with Mr. Ellet's plan of adding 5 feet to the low water depth, and according to this mode of reasoning, a 50 feet flood on the natural river would cause a 55 feet flood on the improved river. To prove this theory we must admit, first, that 5 feet in depth near the bottom where the whole depth is but 6 feet, flowing, say 2 miles an hour, will discharge the same quantity of water as 5 feet in depth on *the top* of a 50 feet flood, one-fourth wider, flowing, say four or more miles per hour; and, secondly, that a river flood flowing 55 feet deep on a descent of 6 inches per mile, will run no faster

* Ellwood Morris desires to state that he has been here misunderstood:—what he did say and mean in substance was, that a 16 feet freshet in the unobstructed river, would, on the slackwater, rise to a height equivalent at least to a 21 feet freshet—*or be augmented at least 5 feet by the dams.*

than if it were but 50 feet deep; both of which admissions would be contrary to a well known natural law. But notwithstanding this result of Mr. Morris's theory, he has not acknowledged, nor has Mr. Ellet, that the permanent increased depth of 5 feet proposed to be obtained by artificial reservoirs, will augment the floods in the Ohio River.

But without attempting to follow all the details of the "Review," the writer desires it to be understood that he has not presented his "Practical Views" for consideration from a mere desire to oppose the Reservoir Plan, or to glorify the plan of Locks and Dams. It can injure no good plan to point out and discuss the practical difficulties likely to attend its execution. Besides, having already stated that if Mr. Ellet's plan can be practically established at a cost *nearly double* of the writer's estimate for the locks and dams, he would prefer that plan, he claims the merit of having at least attempted to make an impartial investigation.

For the Journal of the Franklin Institute.

On Spring Bumpers for Railroad Trains.

Whenever a serious collision takes place upon one of our railroads, (unfortunately a frequent occurrence,) the newspapers are filled for a week or more with all kinds of inventions, which, had they been applied, would have prevented all unpleasant consequences. A favorite means for this purpose is, the attaching in front of the train (and behind it,) a powerful spring which is to take and destroy the shock. It cannot, indeed, be expected, that men of practical information should take the trouble to reply to all these absurdities of our daily press; and yet, it is to be regretted that they are not sometimes noticed, for by dint of constant repetition, they impress themselves on the public mind, and break out like a malignant ulcer, at various times and different places.

Mr. Phillips, in a note read before the Academy of Sciences at Paris, has done this service to the "Parachoc" or "Spring Collision Guard," and has done it effectually. After establishing the formula for the effort of a spring elongated or compressed by a blow, he applies the numerical values, and shows that, supposing the *parachoc* to be at rest, and a train weighing 90 tons and moving with a velocity of $37\frac{1}{4}$ miles per hour to strike it, the spring, made of the best steel, must weigh 30·845 tons in order to resist the shock without breaking, but not without being permanently unfitted for farther use.

If the striking train weighs 112 tons, moving with a velocity of 28 miles per hour, the spring must weigh 21·6 tons.

Tons.	Miles per hour.	Tons.
Weight of train = 208	Velocity = 21·75	Weight of spring = 24·25
" = 600	" = 12·5	" = 22·85

The formula is $W = 0{\cdot}0952\ W\ V^2$.

Where W = the required weight of the spring made of good steel, W = the weight of the train, and V its velocity, (the units of measure being the French kilogramme and kilometre.)

*On the Theory of Pile-driving.** By Michael Scott & John Robertson.

[Read before the Institution of Mechanical Engineers.]

The subject of pile-driving has been investigated by Dr. Whewell on principles first laid down by the present Astronomer Royal; but unfortunately the mathematical expressions which contain the result are so complicated, that, although the distance a pile will be driven may be ascertained, provided the data be correct, by the substitution of numerical values in the different equations, still the process is tedious and the result unsatisfactory. For the object of such investigations is not to determine to a fraction of an inch the distance a pile may be driven, more especially as the resistance offered by the ground, which forms the most important element in the calculation, can never be correctly ascertained;—but the object is to elicit those simple and general truths upon which the system depends. By supposing the pile to be only just stirred by the blow, Dr. Whewell has simplified the equations to such an extent as to deduce from them the following corollaries, which are arrived at by approximation; this approximation, however, holds good only when the quantities are so exceedingly small that the first two terms of a series which does not converge may be assumed to express the value of the whole series. The deductions are,—

1st. A slight increase in the hardness of the pile or in the weight of the ram will increase considerably the distance driven.

2d. The resistance being great, the lighter the pile the faster it will be driven.

3d. The distance driven varies as the cube of the weight of the ram.

Although these results cannot be depended upon as exact under all circumstances, they still give a tolerably correct indication, and are in accordance with those which may be arrived at by general reasoning. The complication in the original expressions arises from taking into consideration in the general question the weight and inertia of the pile. The weight of the pile, however, bears so small a proportion to the resistance of the ground that it may be safely neglected: for a 25 feet pile, 1 foot square, weighs about $\frac{1}{2}$-ton; and if the fall of a ram weighing 1 ton be 10 ft., and the distance driven by the blow be 2 ins., then the resistance offered by the ground, supposing the ram and pile to be perfectly hard, will be to the weight of the ram as 120 inches to 2 inches; that is, it will be 60 tons, of which $\frac{1}{2}$-ton is the $\frac{1}{120}$th part, and may therefore safely be neglected. But the inertia of the pile having to be compared with that of the ram is of more importance, the proportion in the case above supposed being as 1 to 2. Although therefore the inertia of the pile be a matter of too much importance to be neglected, it may nevertheless be considered separately, to the great simplification of the question involving the compressibility of the pile and ram.

If a body at rest be impinged upon by a body in motion, the two will, if inelastic, move on together, the momentum of the whole mass after impact being the same as that of the impinging body before impact; if they be elastic, the momentum of the two bodies together is still the

* From the Lond. Civ. Eng. and Arch. Jour., Dec., 1857.

same, but the distribution is different. The two extremes of these conditions of things may be illustrated by a small hammer striking a pile or anvil, and a sledge hammer striking a nail; in the first case, the hammer buries itself in the head of the pile, or rebounds from the anvil, without producing any further effect; in the second, the existence of the nail scarcely affects the motion or the blow of the sledge hammer. These two cases show at once the great advantage of mass in the striking body as compared with the mass of the body driven. In pile-driving the proportions between an ordinarily heavy hammer and a nail can never be approximated to; but we may conclude with safety that within the limits imposed by practical considerations of convenience, and provided the material of the pile will stand the blow, the heavier the ram the more effective it will be.

Thus far the influence of mass has been considered only in overcoming the inertia of the pile; the same reasoning applies to show that the heavier the ram, and consequently the greater its momentum, the greater is its power to overcome the resistance of the ground. So long as piling engines were worked by hand, any increase of weight of the ram beyond ½-ton or ¾-ton was seldom or never thought of; and, the space for the application of the power of men being very limited, the motion was necessarily very slow. The introduction of steam has removed this difficulty, and in Nasmyth's steam pile-engine the weight of the ram was increased to 1½ tons.

It remains to examine the effect of the height of fall of the ram, of which no mention has yet been made. The writers believe there has hitherto been a prevailing opinion that a rapid succession of blows from a moderately heavy ram with a short fall is more advantageous than with a high fall and proportionately diminished number of blows; for it is alleged the pile never gets leave to come to rest. This opinion however they consider to be erroneous.

Let H be the height of fall, W the weight of the ram, R the resistance of the ground, and S the space through which the pile is driven; then, neglecting the inertia of the pile, and supposing the ram and pile to be perfectly hard,

$$S = \frac{W\,H}{R} \quad . \quad . \quad . \quad . \quad (1)$$

But the ram and especially the pile are not perfectly hard; they are compressible and elastic, although imperfectly so. Let therefore A and B be the hardness of the ram and of the pile; then the space through which a nail is driven, that is, a body whose inertia may be neglected, is

$$S = \frac{W\,H}{R} - \left(\frac{1}{A} + \frac{1}{B}\right)\frac{R}{2} \quad . \quad . \quad . \quad . \quad (2)$$

as given in Whewell's work before mentioned, to which reference is made for the steps of the present investigation. The last term in this equation is therefore the defect arising from imperfect hardness, and is less as the hardness is greater, or as the joint compressibility of the ram and pile is less.

This equation leads to a result of great practical importance. For every position of the pile there is a certain value of the resistance R; and for this value of R there is some value of H, the height of fall, which will make the second side of the equation (2) equal to zero. There is therefore a certain fall which will not drive the pile at all, however great the number of blows, the only effect produced being to soften the head of the pile by continual hammering, and consequently to make matters worse. This is not a theoretical case only: in driving the piles for the foundations of the piers of the High Level Bridge at Newcastle, it frequently happened that Nasmyth's steam pile-driver hammered on the head of a pile for a considerable time without producing any other effect than softening the head of the pile, and making it necessary to cut it off several times. It must be observed that this effect, or rather absence of effect, is due not to the compressibility of the pile only, but to the total amount of yielding from whatever cause arising. If the soil yields the same result follows; and yielding of the soil is worse than any ordinary compressibility in the pile, because it is far greater in amount. This accounts for the difficulty of driving in sand, and for the rebound of the pile that has been often observed.

But although it may seldom happen that absolutely no effect is produced, a diminution of effect must always take place; and the important point to be noticed is that, for a given degree of hardness and given resistance, the *proportion* of loss is diminished by increasing the height of the fall. For supposing the fall required to compensate for the defect arising from imperfect hardness to be 2 feet, and the actual fall of the ram 4 feet, the loss is then one-half; but if the fall be 8 feet the loss is only one-fourth. Now the power required to raise the ram 8 feet is the same as to raise it twice to a height of 4 feet in the same time; but the useful effect in the first instance is represented by $8-2=6$, and in the second by $2(4-2)=4$; or, for the same expenditure of power, the useful effect is half as much again with the higher fall.

Again we have from the equation (2), when s the space through which the pile is driven equals zero, $\frac{W H}{R} = \left(\frac{1}{A} + \frac{1}{B}\right)\frac{R}{2}$.

Whence
$$H = \frac{1}{2}\left(\frac{1}{A} + \frac{1}{B}\right)\frac{R^2}{W} \quad . \quad . \quad . \quad . \quad (3)$$

or the height of fall which represents the defect arising from imperfect hardness varies as the square of the resistance and inversely as the weight of the ram. Hence it appears that if the fall be kept constantly the same as in the steam-hammer piling machines, although at first the pile may be driven with facility, a point may be rapidly attained when the resistance and yielding of the pile will render the blow useless. For suppose at a given point the fall required to compensate the defective hardness be 1 foot, then when the resistance is doubled the fall must be 4 feet; whereas the stroke of Nasmyth's ram is only 3 feet. On the other hand, when the ram is raised to the same point throughout the driving of a pile, the deeper the pile is in the ground, and consequently the greater the resistance, the greater too is the power of the ram.

It appears also from the equation (3), that the heavier the ram, the less is the height of fall lost; and since it was found before that, in regard to the effect when the inertia of the pile is taken into consideration, the heavier the ram is, the better the effect; therefore on both accounts it is desirable to have as heavy a ram as possible.

It has been observed that the fall of Nasmyth's ram is equal to 3 feet; and as the writers believe that there is some misconception about the fall to which the stroke of this ram is supposed to be equivalent, it may be well to examine the matter, assuming, as they believe is the case, that the stroke of the ram, measured from the lowest point to the top of the opening which admits the atmosphere above the piston, is 2 feet 8 ins., and that the remaining length of cylinder above the opening, which is the space allowed for the compression of the air, is 4 inches. The weight of the cylinder and case together is $1\frac{1}{2}$ tons; when therefore the air in the top of the cylinder is compressed to such an extent that its excess of pressure above the atmosphere acting over the area of the cylinder is capable of balancing $1\frac{1}{2}$ tons, the case will rise: if it does not rise, the upward motion of the ram has been destroyed before that pressure was attained;—in reality, however, it does rise, but only about $\frac{1}{4}$-inch, showing that the pressure has been just attained. In the fall of the ram, the recoil of the cushion of compressed air acts upon the piston attached to the ram until the piston has passed the opening communicating with the external atmosphere; and the force of the recoil, together with the force of gravity acting during the same period, accordingly impart the same velocity to the piston as it had when passing the opening in its ascent. The question therefore resolves itself into ascertaining this velocity and the height of the fall to which it is equivalent. The velocity is readily determined by calculating the distance required to be moved through by the piston after it has begun to compress the air in the top of the cylinder, in order to produce the degree of compression necessary for balancing the weight of the cylinder and case; remembering that the motion of the piston must cease at that point, otherwise the case would be lifted. This distance is found to be $3\frac{1}{4}$ inches, and the velocity produced by the recoil of the air in expanding after its compression and by gravity, is the velocity which has been destroyed by the resistance of the air to compression and by gravity, and is that which would be acquired by falling through a height of 4 inches; which is therefore the extra height of fall due to the cushion of compressed air. The 4 inches being added to the actual fall (2 ft. 8 ins.) give 3 feet for the total fall of the ram in Nasmyth's pile-driver, as before stated.

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*Lord Brougham on Railway Accidents.**

Lord Brougham read the following paper at the meeting of the National Association for the Promotion of Social Science at Birmingham, on Wednesday week:—

The time appears to be come, if, indeed, it has not long since arrived,

* From Herapath's Railway Journal, No. 960.

when some effectual precaution should be taken for the security of life and limb in railway travel; and there are some propositions on this subject so manifest upon the least attention which can be given to it, that we may venture to begin by stating them, with hardly any demonstration.

1. It is undeniable that the vast extent of traffic renders it not only justifiable, but necessary, for the public authority to interpose and endeavor to prevent needless risks being run by the community.

2. It is not a valid objection to such interposition, that the conduct of their business should be left to the Companies themselves, and that the state has no right to interfere with private concerns. The concerns are not private. No railway can be established without an act of parliament, and every such act gives powers, not only of an extraordinary, but of a transcendental kind to the undertakers. They are authorized to travel through men's lands without their consent, and to purchase those lands at prices not fixed by the vendor, but by a jury. They have many other privileges by special laws much in their favor, and against the law of the land; but enough has been said on this head when we state that all rights of property, all settlements by will or by marriage contract, all bargains previously made by the landowners, are utterly disregarded, and the whole is thrown under the power and at the mercy of the Companies.

3. It is equally undeniable, that, when the safety of the public welfare is concerned, we have no right to regard the interest or the caprices of one class any more than the interest or the good pleasure of the Companies. Suppose it were admitted that certain arrangements are required to satisfy one, even a considerable body of persons, if those arrangements are plainly prejudicial to the rest of the travelers—not merely displeasing to them but perilous to them—the question is decided that such arrangements should not be permitted; and the only matter for consideration is how they shall be prevented.

4. It may be alleged that persons unconnected with railway administration are not sufficiently qualified to form a sound opinion upon the different matters involved in the inquiry, whence arise the accidents so much complained of, and how they are to be prevented. But this being admitted as a general proposition, it may very likely be also quite true, that there are some things so palpably evident that any one is as capable of understanding them, as if he had spent all his life at a railway board, and that no proof needs be given of them, because they are next to self-evident.

Now, to apply these general principles, there wants but little consideration of the subject. In the first place, without the least railway experience, every one must be aware that the whole plant, and all the carriages and tackle of a railway, is inevitably and constantly undergoing a great wear and tear, very much greater than in any other traveling establishment, because the great velocity of the movement unavoidably increases the friction exceedingly, and causes more jolts and other concussions which directly affect the rails, and the carriages, and the tackle. Secondly, the disposition of the Companies will always be

to grudge the necessary outlay for repairing damage, and preventing its recurrence, because the amount of the dividend is the primary object, in order to maintain the market value of the shares, and their manner of grudging it will be underrating the necessity. Thirdly, the damage occasioned by wear and tear has an unavoidable tendency to increase the geometrical progression, each injury, if not remedied, becoming the foundation of other injuries. Fourthly, if there can be pointed out a cause either certain, or very likely to produce injuries, either by increasing unnecessarily the wear and tear, or by augmenting the number of concussions, or by rendering them greater when they do happen, or even only by increasing the risk of their happening, that cause ought to be removed at once, instead of trusting to the efficacy of vigilant superintendence, or inquiring into the existence of injuries as actually sustained; because, such superintendence and inquiry may or may not prove effectual; whereas the removal of the cause must altogether prevent the evil, or greatly lessen its amount; and we are here speaking only of the wear and tear. Fifthly, such wear and tear must, if not either prevented or remedied, occasion so great a risk of accidents as almost to become a certainty. Sixthly, the length of time that most of the great railways have been established, makes it manifest that they have very much greater chance of accidents now than they ever had before. Seventhly, the prevention of accidents otherwise than by the effects of wear and tear, is most likely also to be secured by whatever lessens that wear and tear—as by accidents caused by concussions and by collisions.

Now, all these considerations point to one thing—the great speed of the movements; and it is too clear to require a word of proof, that whatever lessens the speed diminishes the wear and tear, the injuries to the carriages, the risks of their running off the line, and, if they do, of their being damaged, and the risks of collision either with other carriages or with fixed obstacles. It is enough to name the rates, in order to be satisfied that they expose to serious risks of collision, and produce the certainty of great wear and tear. Hardly any rate is known in this country under an average of 40 miles an hour, while some have 50, and some as much as 60, or a mile a minute; and even where such is not the average, excessive speed is occasionally given to make up for lost time. So that an average of 40 implies occasionally one of 60, and an average of 60 one of 70, 80, or it may be more. Now, it is quite manifest that the risks are very great arising from such rapid movement, both by the damage done to the rails, carriages, and tackle, and by the accidents thence arising; and also where no mischief arises from the disrepair, from the collisions, and other consequences of rapid movement, the prevention of such movement removes the risk, and renders the traveling reasonably safe, even if a very considerable speed should still be permitted. Suppose the maximum of 25 or 30 miles an hour were fixed, and a prohibition of exceeding this in order to make up lost time; in a word, suppose the inconvenience to be inflicted upon travelers of arriving somewhat later at their journey's end, and of occasionally waiting at the station on account of some accidental delay not

allowed to be prevented by increase of speed, can this be put in the balance and weighed against the absolute, or nearly absolute, security against bad accidents which would thus be given? That is the only question, and it does not seem to admit of much doubt. Let it be observed that no reference has been made to the clear opinion given by the most experienced engineers, such as Mr. G. Stephenson, upon the too great speed being the cause of accidents, because it is better to rely upon the nature of the thing itself; and no testimony, nor any authority, is wanted to prove that such rapid motion must produce the consequences ascribed to it.

Then it remains to consider the justification of the proposed prohibition. The advantages of such traveling, as saving time, and thus giving valuable facilities to the transaction of business, as well as accommodation to persons bent upon change of residence or other pursuits, cannot be denied. Nor can it be doubted that there are many who, if asked whether they would, for the sake of the speed, incur the risk, would answer in the affirmative. But it is equally undeniable that a very great majority of those who travel would prefer the security, and declare themselves satisfied with a moderate speed—with going from London to York or Liverpool in eight hours, and to Edinburgh in ten. Why are they to be sacrificed because some others insist on moving with double that speed? It is a common remark of those who reflect little upon the subject, that if accidents happen it is the fault of the public, which calls for 50 or 60 miles an hour; and they add, "*Volenti non fit injuria.*" But the *volentes* are only few comparatively, and the body of the travelers—that is, the public—make no such demand. The anxious vigilance with which our law, like that of all civilized communities, watches over life, is not to be lost sight of. Severe punishment is inflicted on any carelessness from which fatal consequences result, only less severe than what is inflicted when deliberate intention of mischief is proved. Nay, the act of self-destruction is regarded as a great offence, and whoever is so grossly negligent of his own personal safety as to occasion his death, without intending it, may be said to commit an offence which bears the same relation to suicide as manslaughter does to murder. But, suppose a person at the request of another puts him to death, the law treats this as murder, and the agent as the murderer, and the request of the deceased is not any kind of defence, and does not make the act manslaughter. These remarks apply first to the class who hazard their own lives in a desire to save time—they are incurring the moral guilt of an offence akin to suicide; but, next, the remarks apply to the same class as risking the lives of others, and thus committing a most grievous offence. It is manifest that the risk which they run themselves, is no defence against the charge of involving others in the same hazard, any more than a duellist stands acquitted of taking away his neighbor's life by the fact that he risks his own. But we have here to deal, not with the minority, or their conduct in requiring the dangerous rate of traveling; our concern is with the supreme power in the state, the Legislature, which is bound to watch over the safety of the whole community, and to prohibit such conduct as exposes its safety

to unnecessary hazards—hazards, too, of the grossest description. If it should be said that the fixing of a maximum speed, with the prohibition of exceeding it to make up for lost time accidentally incurred, would diminish the security of the public by making the Companies more careless, the answer is, that this never could be the result as long as the present liabilities continued; because no one contends that, by fixing the maximum, the law should declare the parties absolved from all other duty, except that of not exceeding the prescribed rate. Every other neglect would be either punishable as an offence, or entail the reparation by way of damages, according to the nature of the negligence; and it would be no kind of defence, nor even any matter of extenuation, so as to mitigate the sentence in the case, if the party proved that the requisition of the law respecting speed had been scrupulously complied with. There can be no doubt that in France, Germany, and Belgium, where the rate does not exceed twenty-five miles an hour, accidents are very much more rare than in this country. It can be as little denied, that by better regulations time might be saved at the stations both here and in those countries. It may probably be found expedient for the benefit both of the shareholders and of the public to introduce a better system of management by paying the functionaries more liberally, and casting more entire responsibility upon them, so as to suffer no interference of the unpaid directors. But this is a large subject, and connects itself with the whole railway administration, as well as the branch immediately under consideration—the prevention of accidents.

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*On the Employment of Rubble Beton, or Concrete, in Works of Engineering and Architecture.** By Mr. J. Rennie.

In commencing the discussion upon Mr. Rennie's Paper, the author gave some further details of works which had been alluded to, and particularly of the Pont de l'Alma. It was stated that the material composing the arches was found originally to dry so irregularly, as to cause cracks in several places. This was first remedied by forming large detached blocks of the concrete *in situ*, and then cementing them together. But a further improvement was made. It was found that in making an arch of nearly 5 feet in thickness, there was unequal expansion and contraction of the materials. To obviate this, a ring of small stones set in cement was first laid, on which a coating of Vassy cement concrete was spread. In fact the arch was built in two rings. As regarded expense, it had been said that the Pont de l'Alma had cost £40,000, but it was believed that £50,000 was more nearly correct. Now a bridge built at Liège, of dressed stone, of 550 ft. in length and 30 feet in width, or 60 ft. longer and half the width of the Alma Bridge, had cost only £26,000. This did not show any great economy in cost, in favor of the use of concrete; but as regarded time, the one was built in nine months, as stated in the Paper, whereas the Liège Bridge occupied three years in its erection.

It was presumed that the Paper was to be taken as a history of rubble

* From the London Artizan, July, 1857.

and concrete up to a certain date, for it did not convey any idea of the extent of its use at the present time. There were now existing, in various parts of Great Britain, some remarkable works in rubble masonry, which had not been alluded to; amongst which might be mentioned the Liverpool and the Birkenhead Docks. It was thought that working in rubble had been greatly neglected, and that engineers had gone to the opposite extreme of building in expensive ashlar. But what was to be most carefully guarded against was the adoption of a hybrid style of masonry, consisting partly of ashlar and partly of rubble. This was looked upon as a dangerous system, as the unequal settling was almost sure to cause the ashlar facing to split, or part from the rubble backing.

It was remarked, as a generally received opinion, that concrete made with carefully washed gravel and sand, was preferable to that which contained an admixture of loam. Now in some instances this had been proved not to be the case, for loam had been used with positive advantage. If expensive processes of making concrete were adopted, it would be better to resort at once to rubble work.

To this it was replied that it had been shown that the composition of the sand ought to bear some relation to the lime with which it was mixed, and that under certain circumstances the presence of marl in the sand was necessary. A careful examination of the treatises on the subject of rubble masonry, showed that little was known as to the weight it would sustain, or the duty it would perform. It was of great importance to ascertain the resisting powers of rubble, composed of different materials, and set in different limes and cements; and also the composition and action of the ingredients which entered into the concrete, or which were mixed up with the rubble.

A distinction ought to be drawn between concrete, or beton, and rubble work. The former was generally used for foundations, or for making an apron between the piers of a bridge, to prevent the evil effects of scour, and also in breakwaters, where large masses of that material were thrown in. In rubble work, the stone formed about three-fourths or five-sixths of the whole mass, whilst in concrete, the proportion was very much less. In this respect the material of ancient buildings occupied a place between the modern concrete and rubble, for in the works of the Romans the stone formed about one-third of the whole mass. The beton used in Russia had been subjected to a pressure of 5 tons per sq. ft. It was made of a particular clay, burnt according to the formula of Vicat, and thus a perfect artificial hydraulic lime had been formed, nearly equal to natural lime.

A description was given of the system followed by the late Mr. Walker and Captain Huddart, in using washed gravel for the backing of quay walls at the East and West India Docks and other places, by which great solidity was attained. Mr. John Rennie subsequently introduced the use of lime with the gravel, forming concrete. Mr. James Walker had used cement concrete very extensively in marine works at Dover, Alderney, and other places, with great success. The concrete used at the two former places was composed of Portland cement mixed with shingle, in the proportions of one part of cement to ten parts of shingle, moulded into blocks varying from 6 to 10 tons in weight.

The general dimensions of that part of the breakwater so constructed, were—medium width 90 ft., composed of a hearting of cement concrete blocks 60 ft. in breadth, protected by range work of blocks of Roach Portland stone, faced with granite, of an average thickness of 15 ft. on each side. The foundation of the wall was 45 ft. below low water of spring tides, and the top rose to 20 ft. above that mark, making a total height of 65 ft.

It had been observed that the quality of the Portland cement was not always uniform, and that expansion, or disintegration of the blocks had taken place two or three months after they were made, and before they were bedded in position, which operation was generally delayed for six or nine months, to allow them to become thoroughly dry. The manufacture of Portland cement was evidently one which required much care, and was not free from risk, though its general employment was satisfactory, and its use was daily extending for all works of civil engineering and architecture.

To this it was replied that the cases of expansion which had been noticed, probably arose from the presence of too much lime in the cement —the result of careless, or improper manufacture, but such results had not been observed in cement supplied by good manufacturers. The lime so found in a free state, and not well incorporated with the other ingredients, would undergo the action of slaking by the atmosphere, and still more rapidly by sea water, and disintegration would ensue.

The manufacture of this cement was essentially one of confidence, and such defects as those mentioned rarely, if ever, occurred with the produce of experienced manufacturers.

With regard to the works at Dover, it was stated that though nearly half a million cubic feet of concrete in blocks were now laid annually, the proportion of breakage scarcely little exceeded one per cent.

The cost of the concrete blocks was assumed to be about one-half of the cost of the stone walls which had originally been intended to have been constructed. The large cubic contents and consequent weight of these blocks, the uniformity of their size, and their close contact, in the work were relied on as prominent advantages in their use.

The French engineers had used concrete blocks, made of lime and artificial pozzolana, at Marseilles, Rochefort, Algiers, and Cherbourg. After a few years' exposure to the sea water, these blocks had disintegrated and fallen to pieces, a result ascribed by M. Vicat to the presence of magnesia in the sea water, which acted injuriously on the lime. It was not without hesitation, therefore, that some years later they had commenced the employment of Portland cement for their beton works; but the results ascertained in the interval, as to its durability, when exposed to the action of sea water, appeared to have justified the present general adoption of that material, even to the extent of using the blocks in external walls, without the protection of stone casing.

The injection of Portland cement into the foundations of the Pont de l'Alma was noticed as a method of forming beton under water, which though allowable in exceptional cases, could not be recommended on the score of economy, as in the case in question a quantity of cement, costing not less than £1500, had been employed, one-third of which

had, in all probability, been washed away by the current, and had never set at all.

At Alderney the depth of water was greater than at Dover, and there was abundance of stone, which was thrown in as "pierre perdue" to form the substratum, and from a depth of 12 ft. below low water a vertical stone wall was brought up, backed by concrete blocks, to form the hearting.

Descriptions were given of the large blocks of concrete used at the new harbor works at Marseilles and at Algiers. They weighed upwards of 50 tons each, and were moulded close to the spot where they were to be used, and then thrown into the sea. At Algiers it was believed that considerable disintegration had taken place, as it was evident that large cavities existed in the work. When the sea was agitated, it was scarcely possible to walk on the mole, on account of the jets of water which were driven through the apertures with great velocity, to considerable distances. The local engineers anticipated that these cavities would in time be closed by the accretions of shells, by which several had been already stopped ; but this presumed that the disintegration of the blocks was not also progressing. It was questioned whether this disintegration had not arisen from the use of artificial instead of natural pozzolana.

Instances were adduced of the absolute overthrowing of walls from the excessive expansion of the cement used ; and even of a thin coating of the same kind of cement having expanded in the same remarkable degree. It was explained that this must have arisen from the admixture of an undue quantity of lime in the cement, an error not unfrequently fallen into by inexperienced manufacturers.

The now too general system of using a quantity of lime in the making of bricks was denounced as injurious; as the lime, when acted upon by water, expanded, split the bricks, and destroyed the work. An instance was adduced where a light-house had been pulled down entirely in consequence of this action.

The extensive use of concrete by the ancients was noticed, and the magnificent works in Rome were quoted as instances of its durability. There it had been used for vaulting, by first constructing ribs of tiles and pozzolana cement, and filling in with concrete. The excellent quality of the natural material which abounded near Rome had, no doubt, contributed to its general and successful employment.

The works of the French engineers, descriptive of their processes in using beton, were mentioned, and a Paper on the subject was promised during the ensuing session, when it was hoped that the members would be prepared to give the comparative prices of marine and other constructions of concrete, and of squared blocks, or of "pierre perdue," as that question had been cautiously avoided on the present occasion.

It was a question whether rubble concrete was really either so effective or so cheap as good bricks and cement for the superstructure of a bridge, however good and applicable it might be for the foundations, to which it had been generally restricted in this country. In such positions it was excellent, and, but for its use, many hazardous works could scarcely have been executed.

*A System of Train Signaling, by which also disabled Trains may telegraph for assistance without the aid of portable apparatus.** By CHARLES V. WALKER, Esq., F.R.S.

When, in the early days of telegraphy, messages were sent and trains were signaled on the same wires, no facilities existed for reducing the apparatus employed for the latter purpose to a simple form. The case is now becoming different, special wires being largely devoted to train signals; hence the present system.

The *instrument* employed is a large electro-magnet, with a movable armature, carrying a stem and a hammer, which latter strikes on a bell by the direct force of magnetism. It is provided with a contact-maker, a spring, the depression which causes a current to circulate. The bobbins are of 4 in. × 3 in.; and are filled with ten pounds of covered copper wire, No. 16 or No. 18. The core is of five-eighth inch iron. The armature and appendages weigh 2¼ ounces. Bells of this kind have been in action for five years without cleaning or repairing. The battery is zinc-graphite, and a solution of 1 sulph. ac. + 8 or 10 water. The plates, 7½ in. × 3 in., are placed in stone pots that contain about a quart, the zinc standing in a gutta percha slipper containing mercury. Batteries of this kind will do their work untended for half a year and longer.

The *language* consists of blows on the bell; the number of blows varies according to the train-signal to be given. The distinctions required for ordinary purposes being few, the bell-language is very appropriate, from its addressing the ear, from its simplicity, and from the facility with which the signals are given and taken. *One* blow is for the starting of an ordinary train; *two*, for an express; *three*, for the arrival of a train; *five*, for stopping all trains; *six*, for testing. This is a general code; other forms of code are used for protecting level crossings and junctions; but the fundamental signals of the general code are of universal application. This system was introduced five years ago on the South Eastern Railway, and at the present time consists of about one hundred bells, to which additions are in progress.

The bells are connected in pairs, both bells being in a circuit that terminates in the earth in the usual way, at each station. The signal is made by depressing the spring from its earth-contact, upon the zinc end of the battery, the graphite end being in permanent connexion with the earth. The battery being thus introduced between the bell and the earth, a current circulates along the wire and produces one blow upon the bell. The home bell may be excluded or not from the circuit, when a signal is sent.

By the above arrangement signals are sent from station to station. But the extreme simplicity of the battery, the bell, and the language allows the arrangements to be so modified that signals may be made on a pair of bells from any joint, intermediate between two bell-stations, without the necessity of providing the signaler with any telegraph or battery, or

* From the London Repertory of Patent Inventions, No. 767.

any electrical apparatus whatever. The addition of this property to the bells does not in any way interfere with their being in perfect action and constant use for the ordinary work of train-signaling, and therefore if the guards of trains and the plate-players of the permanent way are provided with a signal for expressing their wants, a great advance is made in telegraphy, and a large element of safety is gained for the traveling public.

It is well known to electricians that, if two equal and opposed currents are presented to the respective ends of a wire, no evidence is manifested of the circulation of electric force; the wire is in a null state, as much so as if no current was presented to it. Taking advantage of this law, in connexion with the simple bell-system above described, the circuit is made to contain the two batteries, one at each station, as well as the pair of bells; the same pole, the graphite, for instance, of each battery being connected with the earth.

When the home-station signaler desires to make a signal, he depresses the spring as before; but the connexions are such, that by this act he excludes his *own* battery from the circuit. The circuit then contains but one battery,—namely, that at the pass station; the current of which is now able to circulate from end to end, being no longer counterbalanced by an equal and opposite current; and consequently the bells are sounded. This, then, is the process for ordinary train-signaling, under this arrangement.

By altering the contact-maker so that it inverts the battery in the circuit, instead of putting it out of circuit, both batteries are made available for each signal; and consequently the power and with it the cost of each may be reduced.

But the null state of the wire is equally well and very readily destroyed, by connecting it with the earth at any point intermediate between the two stations; for by this process a complete circuit is made or channel opened for the discharge of both ends of both batteries, each independently of the other, except that the attached wire between the earth and the telegraph wire is common to both circuits, and thus the bells at the respective stations are actuated by the batteries of the respective stations. If ten blows with the pause of a minute, and then ten more, is the signal that the engine is disabled; ten blows, and a minute of contact, that an accident has happened; a ringing continued beyond ten, that the permanent way is obstructed, the stations at either side are advised, and can take the measures necessary to meet the case.

These contacts may be made by hooking a wire or rod on to the line wire and making the necessary contacts with the rail; or, which is better, by establishing contact-makers, properly secured, at frequent intervals on the telegraph posts.

This system gives to those in charge of disabled trains, a certain means of asking for assistance from any point of the open railway, without any training beyond that of *counting ten* slowly and correctly. In practice, as between Red-hill and Reigate, no inconvenience or loss of electricity has been suffered from counterbalancing the two currents.—*Philosophical Magazine.*

For the Journal of the Franklin Institute.

Launch of the Steamship Leviathan. By A. C. JONES, Engineer.

The latest news from England states, that after many abortive trials at great expense, and with a total destruction of the mechanism employed to launch the great steamship "*Leviathan*," it was abandoned for the time. Considering that a failure like this sets the world back in its progress, I may be excused in offering our transatlantic cousins the following hints, which may assist in helping them out of their difficulty; for the ship must be launched, and the present question is how it can be done without a ruinous cost. In my own experience, I have found that sleight was often superior to strength, or its equal, at much less cost. It seems that the bearing surfaces of the ways and cradle were composed of wrought iron. This was a grave error; for it is well known that this metal produces the greatest amount of friction when acting on itself.

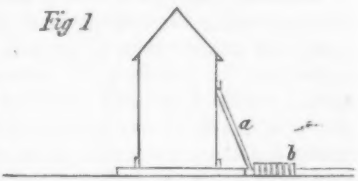
Practical men are well aware that the slides of horizontal steam engines are frequently abraded by the iron or brass gibs of the cross head, and that such an effect is neutralized by the insertion of a slip of sheet copper between the rubbing surfaces. Now, if this simple fact had been known to the engineers of the *Leviathan*, and a sheet of copper had been interposed between the cradle and ways, none of the present obstacles from friction would have been encountered, and a successful launch would have been the result. Even if the copper was crushed, (which is not possible,) it would still act as a lubricator to the iron surfaces, independent of the usual coating of the ways with tallow, white lead, &c. After the mistake was found out that the cradle would not slip, copper sheets could have been inserted by raising the ship, not by the use of hydraulic rams and such expensive apparatus, but simply by using *heat* as an auxiliary, or, in other words, by the power obtained by expansion.

If a sufficient number of metal props had been placed under the keel and other accessible parts, and each of these props had been surrounded by a movable case, converting it into a furnace for charcoal or gas, as solid a base as possible being obtained for each stud, and double wedges being fitted and driven tightly at their heads, heat is then to be applied to the props, and the first effect will be to settle the foundations, each alternate prop being cooled by water; the quoins at the heads are to be "set up," and heat applied again, each set going through the same operation, until the settling ceased, and then the hull would be raised. Here you have an irresistible power, "slow but sure," which would not only raise the great weight of the *Leviathan*, but the globe itself, if a base could be found to support it.

Some thirty years ago, a two storied frame building, 60 feet long by 30 feet wide, was required to be removed about ten feet, and I set to work *unaided* to shift it. Under the building, I placed horizontal timbers, similar to the ways and cradle used in launching vessels; the bearing surfaces being well greased, the ways and the building were raised by wedges, and all other supports removed, "shores" were then placed against the side of the building; one is seen at *a*, fig. 1; their lower

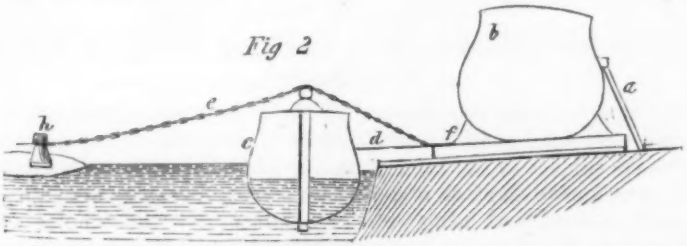
ends rested on plank, and stakes *b*, were driven into the ground to form a backing; between the heel of the shore and the backing stakes wedges were driven from both sides. The driving of the wedges was begun at one end of the building, and the others in succession, and then back to the starting point, and so on; in two days the building reached the desired distance by a one man power process. It will be seen that the prop acts on the principle of the toggle joint, and exerts great power with a small amount of force expended by the wedges at the heel, and that its action is first to lift the side of the house, and then its angle inclines the building to slide over the ways.

Fig 1



In the year 1853, at New Orleans, I had a vessel constructed of heavy timber.* This was built on the side of a narrow canal, and had to be launched sidewise; having fears that the hull would move too fast, and lodge on the opposite bank,† I, like Mr. Brunel, used similar precautions (on a small scale) to prevent a too rapid movement down the ways. All being prepared, off she started, and went about five feet, until the speed became beautifully less, and finally she stuck fast, and the launch was a "flash in the pan." The cause of the failure was soon found out; the alluvial bank giving away, the ways under the hull sunk with it, and so altered their angle, that gravity had not sufficient power. Next day, three screw jacks were placed directly against the cradle to push her off, without any useful effect, and I then bethought me of the shore principle as explained above; but, instead of the wedges, the screw jacks were placed against the heels of the shores. By 4 P. M. the hull was afloat in the canal.

Fig 2



As there is six feet of water above the keel at high water, it is too late to bring in the aid of expansion, or interposing copper between the ways and cradle; but I will suggest another power, in conjunction with the "shore principle," which is feasible, and that is a power obtained

* It was for the most powerful dredger in the world.

† This fear was *imaginary;* for if we take into consideration the large surface presented by the side, and the resistance from displacement of the water, no great distance could be reached by the hull, after it was afloat, nor injury to it from the yielding element before it; all that is necessary to provide against, in the case of the *Leviathan*, is, that one end does not move faster than the other.

by the displacement of water, which, in many cases, has not been made available by engineers. Two forces are required to counteract the excess of friction, namely, a lifting and pulling or pushing power, to effect the launching. Let there be a series of strong shores, *a*, fig. 2, placed along the inshore side of the hull *b*, and two or more large vessels *c*, be moored to the cradle by the hawsers *d*, and strong chains *e*, be attached to the cradle *f*, passing over the hull *c*, to be made fast to the opposite shore, where there are to be proper fixtures to take up the slack. At low water the floats *c* are allowed to sink to a certain extent, by letting water into their holds, and then all the slack of the chains are to be taken in and made securely fast, and the pump or other means to discharge the water from the hold set to work. As this is going on, and the tide is rising, you have a power acting on the nearly straight chains equal to the displacement of the hull restrained from rising; and this power will act both as a lifting and pulling force on the cradle, at the same time the "shores" *a*, are acted upon at their heels, producing a similar effect to raise and push the hull. The nearly straight chains *e*, from the hull to the shore, will, by their own weight, exert much force, and this could be increased at high water by a heavily loaded "traveler" *n*, being hauled out midway on the chains.

If one end of the hull moved too fast, the chains over the floats would slack and swag down, exerting but a slight force. If the hull moved parallel, no injury to it or the floats would ensue, for the weight of the swagging chain would keep the floats in advance, and the body of water between the hull and the floats would have to be displaced before they would come in contact; and it would act as a cushion, similar to the elastic balls used in lecture rooms.

For the Journal of the Franklin Institute.

On Boilers and Surface Condensers. By Thomas Prosser, of New York, Civil Engineer.

The very valuable experiments of Mr. Isherwood, elaborated in the last May and June numbers of this Journal, have a most important bearing on the subject at the head of this article. Taken in connexion with other well-known facts of a similar character, these experiments prove to me the necessity of using iron for condensers of the tubular surface kind, unless, using copper, we are prepared to go back to the same expensive material for tubular boilers also, notwithstanding the evident tendency among engineers to employ high pressure steam for ocean steamers.

The utility of experiments, such as Mr. Isherwood has frequently communicated with so much ability and care, are not easily overrated, and are entitled to more attention than they appear to have received. The experiments now referred to, were made at the steam flour mills of Messrs. Hecker & Brother, New York;* and I wish to be allowed to make a few observations on some parts, which have a very direct bearing on my

* Vol. xxxiii. (3d S.) pp. 278 and 370.

subject, and to correct some errors of calculation, which do not, however, affect the general results of the experiments, nor the deductions therefrom.

The condensing surface is very small, as compared with the recipient heating surface in the boiler, being about as 1 to 3·848; but, inasmuch as in practice, the grate and recipient heating surfaces bear no assignable proportions to each other, I prefer to compare the grate directly with the condensing surface, which is as 1 to 5·281; avoiding, by this method, all the numerous errors involved in calculating the heating surface of the boiler, and in fact all theories of any boiler whatever, having only to regard the quantities of fuel consumed and of water of condensation collected, together with that of the condensing water, and of course the temperatures of both waters. It is much to be regretted, however, that both quantities are given from calculations, instead of by actual weighing, particularly where so fine an opportunity occurred, during any definite number of strokes of the engines and pump, from which something reliable might have been attained. Instead of this, we have the fallacious method of calculating the weight of the water evaporated from the capacity of the cylinder and passages, after it has been expanded 1700 times, when, as I contend, we have no sufficient knowledge either of the absolute weight of water which has left the boiler in the state of steam, nor of the total heat carried with it, even if we had the weight of water, for some of it may have primed over, although, in this case, probably not much.

In the last experiments, (p. 376,) the average pressure of the steam in the boiler was 91 lbs. per square inch above the atmosphere, the temperature due to which is about 336° Fahr., and its total heat about 1184° above 32°. Now, in the calculations on the "efficiency of the condenser," (p. 381,) the total heat of steam at atmospheric pressure is adopted, viz: 1146·6° Fahr., thus leaving 37·4°, (=1184—1146·6,) or more than three per centum of the total heat in the steam unaccounted for. It *may* be that just this amount of heat is lost by radiation, and is just sufficient to prevent condensation in the cylinder, and if so, then the calculation *may* be about correct, but, in point of fact, it is all mere guess work, for we know but little of that which we cannot see, and not much of that which we can see.

Another still less fortunate guess is, that the cold water pump discharged but "two-thirds of its capacity of water," or 17 lbs. to condense 1 lb. of steam at atmospheric pressure, which cannot be, for such steam requires nearly all the water which the pump can deliver to condense it, and $23{\cdot}831 = \left(\frac{1048{\cdot}6}{44}\right) = \left(\frac{1146{\cdot}6-(130-32}{80-36}\right)$ lbs. is the least possible quantity of water which will effect it.

The equation (p. 381) "$\left(\frac{1146{\cdot}6-130}{130-36}\right)10{\cdot}81$ lbs.," intended to show the difference between the quantities of condensing water required, by surface and by injection condensation, is erroneous to a small extent, and needs correction only on account of the comparison which I wish to make hereafter.

The total heat in atmospheric steam is 1146·6 above 32° Fahr., and that is condensed and reduced to water at 130° Fahr., or 98° above 32°, so that the formula should stand thus:—

$$\left(\frac{1146{\cdot}6-98}{130-36}\right) 11{\cdot}155.$$

Now, in this case, the condensing water gains 94°=(130—36,) while in the former one the gain is but 44°=(80—36,) and of course the quantities of condensing water required in the two cases are in the inverse proportions of 44 and 94, or as 23·831 to 11·155. This shows the danger of guessing, when other means are available, and also the danger in using a very awkward scale of temperature, instead of the beautifully simple, but very convenient and scientific centigrade.

Owing to the very low temperature of the condensing water, (36°,) these examples do not apply to ordinary cases by any method of condensation, for the condensing water of an air pump surface condenser seldom gains on the average more than 20°=(say 80—60,) if anything like a good vacuum is desired. In Hall's condenser, which is by far the best of its class, the vacuum is usually from 29 to 30 inches, but the condensing water only gains about 16° on the average, and consequently requires 67 lbs. of it to condense 1 lb. of steam.

The very low temperature of the condenser, and the consequent enormous condensation in the cylinder, requires 1·5 lbs. of feed water per minute, per horse power; consequently, *three tons per hour* for each horse power must be passed through the condenser. Need we be surprised, then, that, with such a torrent, the copper of the condensing tubes is carried into the boiler from the hot-well, and with it the elements of destruction? Add to this, the slightest leakage of salt water into the copper condensing tubes, and the case is completely made out, why surface condensers have never succeeded. Moreover, the machinery necessary to effect the operations, the space occupied by it, and the enormous dead weight carried, are together so enormous as to be almost incredible; nor is the boiler one whit less wonderful for the same qualities.

To return from this digression to the boiler mentioned at page 380, where Mr. Isherwood states, that "particular plates have been found deeply honey-combed, while others adjoining were nearly as sound as ever;" and "about these portions of the boiler," "salts of copper were found, carried there from the copper pipes of the condenser." But "pure water is used in the boilers, and any deficiency is supplied by rain water." Again, he says: "The wasting of the metal appears to have been *about* equal on *both* sides the copper; that is to say, on both the sea water and distilled water sides." How is this? "Pure water" is generally supposed to have no effect whatever upon copper, whether hot or cold; but cold *sea* water has a very powerful effect upon it, and the difficulty of making a surface condenser perfectly tight, is far greater than is generally imagined, and particularly where the water is cold. That this condenser leaked,* as did also the one referred to in the 15th vol. (3 S.) p. 131 of this Journal, where the density of the water in the boiler

* Since writing this, I have ascertained that the condenser did leak sometimes, but is *supposed* not to have done so at the time the experiments were made.

increased without any assignable cause, is beyond a doubt; for nothing else that can be imagined will account for the facts.

Copper, under some circumstances, will doubtless stand longer than iron, on account of its greater homogeneousness, as well as flexibility and toughness. Iron tubes *under coercion*, will sometimes give out in an incredible short time, where each end is rigidly fixed, and the middle is subjected to violent changes of heat and cold, causing the scale to fly off, and exposes the clean iron to the action of sea water.

If we assume, in the experiments before us, that the condenser of copper and the cross-boiler of iron are each of the same value to renew, and also that no more danger attends the wearing out of the one than of the other, it does not appear to be of much importance which goes first. But, when the *destroyer* is of more than three times the cost necessary, and further, when, by reducing its cost in that proportion, by substituting iron for copper, it becomes the *destroyed* instead, it does appear surprising that copper condensers should be thought of in connexion with iron boilers.

It is but a few years since, that the fallacy of using copper boilers was exploded; and now we have to contend with a still greater evil and a more dangerous one too, (unless we are prepared to go back to copper boilers,) for so rapid is the destruction of iron boilers by salts of copper in sea water, that a boiler may be reduced to a most dangerous condition in a few weeks. I have known the boilers of a sea-going steamer almost destroyed by this means, in an incredible short space of time, where the bilgewater, with salts of copper in solution, was used for injection, and thus got into the boilers from the hot-well; so that more than 500 iron tubes and several plates of the boilers had to be removed, being completely honey-combed in the direction taken by the feed-water.

Another source from which salts of copper may get into the feed water of a boiler from a copper surface condenser is, the oil and fat in the exhaust steam, which remaining upon the copper when *cold*, rapidly absorbs air, becomes oxygenated, and attacks the copper.

Notwithstanding the great defects of the condenser experimented upon, Mr. Isherwood affirms that the results obtained are "very remarkable," and that "the uniform satisfaction it has always given must not be overlooked."

The defects I consider to be in the use of copper, and that too in the shape of large tubes, so that the steam has to expand itself enormously, to come in contact with the condensing surface. Next, the condensed steam being open to the atmosphere, necessarily limiting its temperature to a low point, and increased enormously the back pressure upon the piston.

In the "*New Method of applying the power of Steam and of Condensing the same*," which I had the honor of promulgating in the 31st vol., p. 343 of this Journal, I believe all the objections to this system of condensation are removed, and many improvements are introduced.

In the first place, the annular spaces between large iron tubes are used, so that the steam has to expand itself but little to come in contact with the condensing surfaces. Next, the condensing, *i. e.* the receding

steam alone gives, (or takes off, shall I not say?) its own back pressure to the piston; and, whatever that may be, the feed water is above 212° Fahr., for the phenomenon does really occur of a reduction of pressure without apparent cause. It happens, whenever a sufficient current is established in a gas-pipe ascending a hill, for a small puncture not only will not allow the gas to escape, but will absolutely draw the air in, and show the "*blue lights*" beyond; and I see no reason to doubt the same effect being produced by very rapid condensation of steam under favorable circumstances.

My system is essentially one of *centralization* and power; whereas all others are on the principle of dispersion, which is weakness. In the former case the steam is operated upon, while yet at a comparatively high but useless temperature, and it is *killed* on the spot, for it cannot travel more than 4 or 5 feet, after entering the condenser, before the full power of the latter is developed and in action. In the other case, the steam is allowed to expand enormously as soon as it leaves the cylinder, and then it goes on its travels to find a condensing surface, until it is so exhausted that there is nothing left to condense but dead inanition, which is dragged out by the air-pump.

Hall's condenser has about 39 feet of surface to 1 foot grate surface, but then he has almost a perfect vacuum. Others have less surface, but a less perfect vacuum, and of course the less air-pump the higher the temperature of the feed-water. Messrs. Hecker & Brother's condenser had no air-pump, but the feed-water was only 122°. Now, in my system, the feed-water need never be as low as 212°, by several degrees, while the back pressure, I have reason to believe, is always below that due to the temperature, for the exhaust steam is in rapid motion, and of course, being *drawn off from the piston, must and does* draw off the pressure from it.*

I know that iron tubes, when properly put together to form condensers, will withstand the action of sea-water for a considerable time, provided they are not too long, but, even if it should be found that they corrode rapidly, there is no doubt, if the statements in the English papers are to be believed, that *Howell's* homogeneous metal will last many years.

Under any circumstances, however, the mere tubes being inexpensive, and the facilities for replacing them very great, there does not appear to be any objection whatever to their use. And now, what is the national stake at issue in connexion with this subject? It is doubtless very presumptuous in me to say that I believe, unless *my method*, or one equally efficacious, is adopted, for condensers of ocean steamers, we must entirely (we have almost done so already), abandon the foreign carrying trade. The monstrous space now occupied with machinery in ocean steamers, together with their first cost, and the enormous expense of working them, are all against this country. But the fuel and its concomitants form by far the greatest evil; and yet, in point of fact, with a system of centralization in the boiler as well as in the condenser, that fuel should be our

* See Dr. E. Alban's work on "The High Pressure Steam Engine," translated by William Pole, C. E., London, note 31, p. 56.

greatest good, for there is no fuel that can be used in such a system equal to the anthracite; and instead of evaporating 6 lbs. of cold water with 1 lb. of it, I have no doubt that 12 lbs. of boiling hot water may be evaporated with that quantity. I am supported in this opinion by the January number of this Journal, p. 58, from which it appears, that in the north of England 12·27 lbs. of boiling water has been evaporated by one pound of coal. One cause of the greater proportional efficacy of the fuel, in operating upon boiling water, probably arises from the water not assuming the spheroidal condition, or, if it does assume it, on coming in contact with the hot iron, it is in a very advanced state of that condition, necessarily so, because, if otherwise, cold water could never be got out of it at all; whereas we know that the water will dance about for some time, and then evaporate pretty quickly at the last, when it has sufficient heat, which it obtains with great difficulty when cold. The fuel, then, is the thing to be operated upon; for, if we can reduce that and its concomitants to one-half, although foreigners may take advantage of our improvements, yet, with a superior fuel for the purpose, and the adoption of those methods of economy which the peculiar nature of our facilities require, instead of following in the wake of foreign improvements, which, in many instances, are not applicable to our wants, the per centage of saving on the whole expenditure will be greatly in our favor.

I may now be allowed to say, that, before I penned the "*Memoir*"* on my new method of using and condensing steam, I had pretty well satisfied myself, by practical experience, that it was correct; and having been engaged upon it ever since, until I have fully worked out the problem, I feel fully justified in pronouncing the air-pump of a surface condensing engine a great mistake. I make this declaration, in full view of the handle which it gives to call hard names, but, as that is and must be the turning point, I prefer to meet the issue so, and thus I throw down the *gauntlet* to all comers to disprove my theory, if they can.

* Vol. xxxi, Third Series, No. 5, May, 1856, p. 343. See also vol. xxxiv, Third Series, No. 3, September, 1857, p. 199.

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*The Original Locomotive Engine of Trevithick.**

Sir,—Whilst employed at the Penydarran Iron-Works, I had frequent opportunities of seeing the principal parts of the original locomotive which was made by Trevithick, as described by Mr. Thomas Ellis in last week's Journal. Some years ago I recommended the late Mr. Ald. Thompson, and also Mr. Forman, to preserve these interesting relics and put them together, as a memento of the original locomotive. I am truly happy to find my old friend Mr. Ellis has taken up the subject, and that the fitter and the driver are still alive, and are able to assist him in the task he has undertaken to perform.

October 27th. Evan Hopkins.

* From the London Mining Journal, No. 1158.

AMERICAN PATENTS.

List of American Patents which issued from November 3d, to November 24th, 1857, (inclusive,) with Exemplifications.

NOVEMBER 3.

1. For an *Improvement in Lime-kilns;* A. G. Anderson, Quincy, Illinois.

"This invention consists in a certain improvement in the so-called 'continuous' or 'perpetual draw' lime-kilns."

Claim.—"The combination of the perforated arch and escape passages, with the throats, chambers, dampers, holes, and supporting and removable bars, the same being constructed and arranged for joint operation."

2. For an *Arrangement of Feed-water Pipes in the Bed of a Steam Engine;* Henry W. Bill, Cuyahoga Falls, Ohio.

Claim.—"Making the bed of a steam engine hollow, and so as to form a steam chamber, and arranging the feed-water pipes in or through said chamber, so that the exhaust steam in the chamber shall heat the feed water in the pipes."

3. For an *Improved Machine for Making Bolts;* Richard H. Cole, St. Louis, Mo.

"This invention consists, first, in pressing the head on the bolt in a moving die or heading box, against a yielding tool, by the motion of the bolt instead of the tool. 2d, In devising means for pointing the bolt, and casting it from the bar in a single operation. 3d, In gripping the bolt between a fixed and yielding jaw, so as to keep the machine from breaking in case anything should get between the said jaws."

Claim.—"Pressing the head on the bolt in a moving die-box or die, and against a yielding tool or support, by the motion of the bolt instead of the tool. Also, the combination of the spring, the crotch, and the jaw, so that the crotch, or its substitute in pressing the jaw forward, shall act against a yielding medium. Also, the internal construction of the gripping tools, whereby each of the said tools in closing, shall form one-fourth of the point on the bolt, thus making half of the point when closed. Also, finishing the point on the bolt, that is, completing it by an offset made on the side of the knife, having a form in it to correspond with the form in the end of the tools; the said offset to be below the cutting edge of the knife, a distance equal to the diameter of the point of the bolt when finished, so as to make the point of the bolt like the frustrum of a cone."

4. For an *Improvement in Curtain Fixtures;* John W. Currier and James M. Thompson, Holyoke, Massachusetts.

Claim.—"The combination of mechanism for rotating the curtain roller, for the purpose of either winding up or unwinding the curtain, the same consisting of the slider, the cords, and the straight and helical grooves for the slider to work in, one of the said grooves being stationary."

5. For an *Improved Rose for Door Knobs;* Samuel S. Day, City of New York.

Claim.—"Combining the slotted flanch, the screw-threaded flanch, and the disk flanch, in the construction of a rose for door knobs."

6. For an *Improved Method of Reversing the Chisel in Mortising Machines;* D. M. Cumming and P. C. Cambridge, Jr., North Enfield, New Hampshire.

Claim.—"Rotating the chisel mandrel from the auger mandrel when desired, by means of the lever with pressure rollers attached, and spur in connexion with the lever, operated by the uprights."

7. For an *Improvement in Apparatus for Mixing and Grinding Oil Paints;* Wm. H. Dolson, City of New York.

Claim.—"The combination of the mixer and grinder, with an intermediate endless belt and scraper."

8. For an *Improved Apparatus for Unloading Vessels;* Robert Ferguson, New Orleans, Louisiana.

Claim.—"The combination of swinging platform, arm, lever, and spring, with the body of the carriage."

9. For an *Improvement in Hoisting Buckets;* George Focht, Reading, Penna.

"This invention consists in certain improvements in buckets for hoisting coal, grain, and other material."

Claim.—"The catch lever, in combination with the lip or roller, and the staple."

10. For an *Improved Candy Twisting Machine;* John Gardner, Philadelphia, Pa.

Claim.—"The working and twisting of candy by means of a machine."

11. For an *Improved Machine for Bending Metal Plates;* E. L. Gaylord, Terryville, Connecticut.

"This invention consists in the employment or use of a clamp, bed-piece, and adjustable stop, by which, in connexion with a drop, or an equivalent device, the desired work is performed in an expeditious and perfect manner."

Claim.—"The block provided with the movable arms and cross-piece, the block or bed-piece, and adjustable stop, arranged and used in connexion with a drop, or its equivalent."

12. For an *Improved Violin Attachment;* Jackson Gorham, Bairdstown, Georgia.

Claim.—"The lever having its fulcrum in a support which is movable on a board or piece attached to the head of the violin, and having a screw, or its equivalent, applied to it."

13. For an *Improvement in Printing Presses;* George P. Gordon, City of New York.

Claim.—"The arrangement of a bed, with its form of types, between two distributing tables, so that the impression may be taken while one table is inking the rollers and distributing the ink, by passing to and fro upon the distributing table on one side, and at the alternate time an impression may be taken while the rollers are passing over the opposite distributing table, thus allowing of the reversal of the rollers at the extreme ends of the two tables, meeting and inking the form in its transit from one extreme to the other, and allowing the impression to be taken at each inking of the form, without waiting for the return of the rollers. Also, the arrangement of the variable eccentric, or its equivalent, with the sheet guides or gauges and friction feed rollers, for the purpose of drawing in evenly the sheet or strip any required distance. Also, the arrangement of means for feeding, printing, cutting, and counting the cards or sheets of paper, with the means for the inking, and alternately distributing the ink."

14. For an *Improved Water Cooling Pitcher;* Alonzo Hebbard, City of New York.

Claim.—"The use of the combination of the woolen cloth or felt covering as an elastic non-conducting packing for a porcelain or glazed ware pitcher, with the said porcelain or glazed ware interior pitcher, and external metallic shell or pitcher, for the purpose of making a water cooling pitcher."

15. For an *Improved Method of Operating Scroll Saws;* John L. Lawton, Baltimore, Maryland.

Claim.—"The method of operating the saw by means of the belts and back levers."

16. For an *Improvement in Iron Truss Frames for Bridges, &c.;* Francis C. Lowthorp, Trenton, New Jersey.

Claim.—"1st, Arranging and constructing the vertical posts of iron truss frame girders for bridges and other structures, in relation to the upper and lower chord, in order that the said posts may be allowed to vibrate on the chords. 2d, Allowing the end posts of truss frame bridges to vibrate on the piers or foundation."

17. For an *Improved Mode of Chamfering and Crozing Barrels;* James H. Mattison, Scriba, New York.

Claim.—"The cams, in combination with the spring, and the chamfering and crozing tools, so constructed as to traverse them out gradually to cut the score, and chamfer a barrel, and draw them in suddenly to remove the barrel, and save the time of the operator attending the machine. Also, making the edges of the rims, which hold the end of the barrel, by making a rebate, or otherwise, so as to hold the barrel properly in the machine, without removing the truss hoops."

18. For an *Improvement in Water Closets;* Francis McGhan, Washington, D. C.

"My invention has reference to the manner of regulating the flow of water to the pan after it has been used."

Claim.—"The adjustable communication between the supply pipe and the chamber above the valve, in combination with the displacing diaphragm, or its equivalent."

19. For an *Improved Rotary Excavator;* Gilbert H. Moore, Rochester, New York.

"This machine consists essentially of a series of spades or shovels attached to the periphery of a wheel, and so arranged that they may be raised or lowered at will."

Claim.—"1st, The construction of the carriers or receivers, viz: the support and hinging of the bodies upon the axle, in such manner that they may be dumped by elevating the two extremities. 2d, The construction and mode of attaching the shield by either of the methods. 3d, The combination of the digging wheel, the carrier, and the shield."

20. For an *Improved Method of Cleaning and Polishing Coffee;* Wm. Newell, Philadelphia, Pennsylvania.

Claim.—"The cleaning and polishing of green coffee, by subjecting it to the combined action of heat, friction, and motion."

21. For an *Improved Method of Expanding Tires;* Samuel Penberthy, Chicago, Ill.

Claim.—"Expanding the tires of locomotive and other heavy wheels while on their axles or shafts, and connected with their vehicles or locomotives, by means of a portable furnace, arranged so that the same may be attached to the tire at any desired point."

22. For an *Improvement in Iron Shutters for Doors, Windows, &c.;* M. C. Root, Toledo, Ohio.

Claim.—"The construction of metallic shutters."

23. For an *Improvement in Canal Lock Gates;* Samuel J. Seeley, City of New York.

Claim.—"The method of connecting the upper journals of canal lock gates to the masonry of the lock, by means of adjustable boxes. Also, suspending the outer or swing edges of the gate to the upper journal boxes by diagonal suspension braces. Also, connecting the two flaps of the gate with each other, so that the two shall move together by means of the joint link and arm, or other equivalent means, in combination with the connexion with a capstan at the side of the lock by a jointed rack, or other equivalent means."

24. For an *Improved Smoothing Iron;* James Goodin, Cincinnati, Ohio.

"This invention consists in the arrangement of the different portions together employed for heating the iron, by which I am enabled to distribute and retain the heat in the bottom of the iron, and keep it sufficiently hot during the time of ironing, without stopping to heat the iron, as is commonly the case with all ordinary methods of heating irons for smoothing purposes with charcoal or gas."

Claim.—"The arrangement of the perforated diaphragm, with the air openings, when said diaphragm and air openings are arranged with the gas pipe and gauge in the bottom of the iron, all for the purpose of detaining and equally distributing the heat over the surface of the bottom of the iron."

25. For an *Improved Mode of Tightening Tires on Carriage Wheels;* N. J. Skaggs, Talladega, Alabama.

Claim.—"Forming the ends of the tire with the heads, recess, and projecting portion, in connexion with the screw-rod, by which the ends are secured together, and the tire contracted as may be desired, and a continuous or perfect joint or connexion obtained."

26. For an *Improved Hand Printing Press;* Samuel J. Smith, City of New York.

Claim.—"The manner of adjusting the lever and its inking roller by the screw, so that the inking takes correctly on to the edge of the printing surface, as said surface moves in a curved line with, and on, the lever. Also, arranging the printing surface and inking table on the lever, in such a manner relatively with the inking roller and its lever, that said roller shall travel over the printing surface as the lever descends, and then pass upon to the inking table for distributing the ink while the impression is being given, at the same time that the paper, or other material being printed, is kept from contact with the roller by the foot."

27. For an *Improvement in Pumps;* Noah Sutton, City of New York.

Claim.—"The peculiar means employed for operating the pistons or giving them the variable movement, viz: the pulleys connected with the bars of the pistons, by means of the chains, the pulleys being placed loosely on their shafts, and connected alternately therewith, by means of the bars connected with the spring, the projections on the wheels, and the beveled projections on the bars."

28. For an *Improved Barometer;* Theodore R. Timby, Medina, New York.

"My invention consists in a mode of constructing barometers, whereby the liability to be broken from expansion of the mercury during transportation is entirely prevented. Also, in suspending the barometer tube in the axis of a cylindrical case having a central hook, so as to save the necessity of leveling or plumbing the instrument."

Claim.—"The mechanical arrangement for supporting the barometer tube within the suspension glass case, the same consisting of the bracing rods, passing through the glass and brass tubes, and the wooden block, the inner cap, the blocks, the lower cap, and the screw joint."

29. For an *Improvement in Harvesters;* Hosea Willard and Robert Ross, Vergennes, Vermont.

Claim.—"The combination of the hinged finger bar with the adjustable bar, lever, regulating set-screw, and wheel, the whole being constructed and arranged in relation to the main frame for joint operation. Also, lever and regulating set-screws, in combination with bar, chain, or cord, pulley, and clutch, for the purpose of raising the hinged finger bar."

30. For an *Improvement in the Joints of Carriage Tops;* Reuben M. Stone, Solsville, New York.

Claim.—"The bars connected by the joints and provided with loops or hooks."

31. For an *Improvement in Machinery for Burring Wool on the Pelt;* John Waterhouse, Little Falls, New York.

"This invention relates to a machine for burring and cleaning wool in the pelts, by clamping said pelts between feeding rollers, and presenting them thus held by the feed rollers to the action of a revolving cylinder, armed with teeth and beaters, so arranged as to comb or straighten out the fibre whilst the beaters knock off the burrs, and other extraneous matter; the pelt being held so as to prevent all danger of being drawn into, torn, or injured by the cylinder."

Claim.—"1st, The combination of the feeding apparatus, which holds and controls the pelt with a clearing cylinder. 2d, The combination of the rollers, one being elastic, and the other non-elastic, for holding and presenting the pelt in a curved or bent form to the action of the cleaning cylinder. 3d, In combination with the holding and presenting rollers, the feeding rollers, one of said rollers being elastic, and the other non-elastic. 4th, Mounting one of the feed rolls and one of the holding and presenting rolls on the main frame, and their fellows upon a traveling carriage, for the purpose of facilitating the introduction, turning, and removal of the pelt."

32. For an *Improvement in Folding Iron Bedsteads;* Henry F. Vandenhove, City of New York.

Claim.—"Applying or attaching the guides or fenders to the bedstead. Also, attaching the buttons to the side pieces, and also attaching the pins or stops to the side pieces, in connexion with the grooves in the inner sides of the posts."

33. For an *Improvement in Sewing Machines;* C. H. Andrus, Assignor to Squire Lee, Goshen, New York.

Claim.—"The employment of a supplementary serrated feeding plate, fitted within a slot in the principal feeding plate, and provided with shoulders, and being controlled entirely by springs applied between it and the principal feeding plate."

34. For an *Improvement in Printing Presses;* Merwin Davis, City of New York, Assignor to Peter G. Bergen, Brooklyn, New York.

Claim.—"The reciprocating rolling pressure segment, provided with a weight-box, or any suitable or equivalent device, by which the counterpoise of the segment may be varied or graduated to be commensurate with the speed of the segment. Also, the

reciprocating rolling pressure segment, irrespective of the variable counterpoise. Also, the reciprocating carriage, provided with the fingers or nippers, in combination with the segment for feeding the sheets to the form. Also, in combination with said segment, the 'fly' or device formed of the rods or shaft's arms, and the hinged ledge or plate, the above feeding and flying devices being arranged and operating conjointly with the segment. Also, the rails applied to the machine, and operated so as to raise or elevate the face of the segment above the form during the one movement, and allowing it to descend and rest upon the bed during the other movement, in order to give the impression to the sheets. Also, the bar, when used in connexion with the rails, and having the bar connected with it, whereby the segment may be raised at any time, and the sheets also prevented from being fed to the form. Also, operating the lateral vibrating ink rollers, by means of the T shaped lever."

35. For an *Improvement in Machines for Folding Paper;* Cyrus Chambers, Jr., Philadelphia, Pennsylvania.

Claim.—"1st, Forcing the edges of the sheet between the folding rollers, in advance of the middle of the said sheet. 2d, Temporarily arresting the motion of the first pair of folding rollers. 3d, The register pins, in combination with the tubes, when the same are arranged for joint operation. 4th, The combination of the first pair of folding rollers, with the register pins, when the latter operate between the former. 5th, Preventing the rebounding of the folded sheet during its passage through the machine, previous to the descent of any of the folding blades, by means of the arresting rollers, the same operating in combination with the tapes. 6th, Dividing the printed sheet into two halves, by means of shears. 7th, Discharging free from the machine, the strip cut from the folded edge of the sheet, by means of a revolving disk. 8th, So constructing and arranging a machine for folding sheets of paper, that the two halves of one sheet (said sheets having been printed on both sides from the same form,) may be separated from each other, and folded in succession. 9th, Packing the folded sheets, by means of a reciprocating plunger, against a frictional plate in a trough, so that the backs and heads of the folded sheet coincide with each other. 10th, The employment of the devices whereby the operator can separate the imperfect from the perfect sheets. 11th, Preventing the return of the packed sheets of paper, by means of the catches situated above, and in the corner of the trough. 12th, The combination and arrangement, by which the operations are performed simultaneously or in succession to each other in the same machine."

36. For an *Improvement in Rock Drills;* George H. Wood, Green Bay, Wisconsin.

Claim.—"The employment, in combination with a drill of a supplementary spring, for the purpose of controlling the rebounding of the drill."

37. For an *Improvement in Vane Governor for Steam Engines, &c.;* Charles Whittier, Roxbury, Massachusetts.

Claim.—"Suspending the fans or vanes on the crank, or its equivalent, attached to the spindle of the regulator valve, whereby the resistance of the atmosphere causes them to operate the valve."

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38. For an *Improvement in Projectiles;* Henry Bates, New London, Connecticut.

Claim.—"The employment of a tail, consisting of a spiral spring or coil of wire applied to the bomb or other projectile. Also, securing the fuse in the fuse tubes of the bomb, by bending the said tubes after the insertion of the fuse therein."

39. For an *Improved Device for forming Round Tenons on Window Blind Slats;* Thomas C. Ball, Keene, New Hampshire.

Claim.—"The arrangement and combination of sliding shoulder cutters, or their equivalents, and sliding tubular journal cutters, to operate together."

40. For an *Improved Sawing Machine;* Harvey Brown, City of New York.

Claim.—"1st, The ways, constructed as shown. 2d, The arrangement of gearing for the purpose of moving the carriages on the ways. 3d, The pulley, with its appendages of the pawl and ratchet wheel, in connexion with the projection and the dogs,

by means of the cords or chains. 4th, The entire arrangement of my mill, by which a series of carriages are brought forward on endless ways to an endless saw, and each log upon its carriage being accurately set as it passes the projection, and thereby securing accuracy, rapidity, and efficiency."

41. For an *Improved Corn Husker;* Joseph Cawthra, Rochester, New York.

Claim.—"The grooved rollers, saw wheel, and endless apron, in combination with the husker, grating, and curved tooth fan."

42. For an *Improved Method of Determining Approximate Latitude at Sea;* Edward Cavendy, City of New York.

Claim.—"The method of determining approximately the zenith of the observer."

43. For an *Improved Earth Moving Machine;* John Cowdon, New Orleans, La.

Claim.—"The combined arrangement of the gear wheels and pulleys, and the chains or cords, all arranged on the shafts for the purpose of giving and regulating the forward motion of the machine, and movement of the elevators. Also, the construction of the elevators, by dividing them into three, more or less, pieces, and arranging the pieces to the chain and hook pieces, for the purpose of causing them to expand or spread for freeing the dirt from the elevators when being discharged. Also, the combination and arrangement of the parts with, and employed for, carrying the end of the conveyer frame, consisting of the carriage, cord, and pulley stake, friction rolls, and driving pulley. Also, the combined arrangement of the shaft nut, wheel axis, with the frame work for elevating and lowering the rear end of the frame of the machine, preparatory for steering and giving the machine direction."

44. For an *Improvement in Distributing Apparatus in Flouring Mills;* James M. Clark, Lancaster, Pennsylvania.

Claim.—"1st, The adjustable or hinged spout, or series of adjustable or hinged spouts, for the purpose of rejecting, mixing, separating, re-bolting, or re-grinding and re-bolting any portion of the lower grades of flour. 2d, The combination of the adjustable or hinged spout, or series of adjustable or hinged spouts, with a single series of slide valves or valve, the circular division, the conveyer, and scrapers."

45. For an *Improvement in Hoisting Apparatus for Bricks, &c.;* John Crawshaw, Rochester, New York.

Claim.—"Elevating articles within a vertical trunk, so that the articles will be raised with a continuous motion within said trunk. Also, the reciprocating plunger, clamps, and arm, operated by the cams, or their equivalents, and used in connexion with the dogs, the whole being arranged to operate conjointly."

46. For an *Improvement in Machines for Pulling Beans;* Justus Day, Murray, New York.

Claim.—"The movable head."

47. For an *Improvement in Rails for Railways;* Timothy Dwight, New Haven, Conn.

Claim.—"The rail with its flanch or flanches, in combination with the sill adapted to fit the lower part of the rail; and these I also claim, in combination with the screw bolt and nut."

48. For an *Improvement in Attaching Steam Gauges to Locomotive Boilers;* I. L. Eastman, Boston, Massachusetts.

Claim.—"Interposing between the gauge and the boiler, the elastic cushion and spring, so that the jar or vibrations of the engine shall not be transmitted to the gauge."

49. For an *Improvement in Seeding Machines;* Albert Franklin, Genoa Cross Roads, Ohio.

Claim.—"The combination of the wedge-shaped or triangularly formed discharge openings of the hopper, with the similar shaped cells in the feed cylinder, arranged for operation in reverse direction to each other, and the several cells in each circular row of said cylinder, forming, though divided, a continuous opening, by means of channels connecting the apex of the one cell with the base of the other."

50. For an *Improvement in Stoves for Burning Tar, Saw-dust, &c.;* Samuel Fisher, Canton, Massachusetts.

Claim.—"An improved stove, as constructed not only with a fuel chamber without

a grate or air passage or passages through its bottom, but with an air chamber arranged in front of the chamber of combustion, and made to communicate therewith, and the external atmosphere and the side flues, whereby air can be supplied laterally to the chamber of combustion, and made to pass over the same and down to the flues; such air not only supporting slow downward combustion of the fuel, but serving to create draft down the flues, so as to carry off the smoke and combustible gases, and prevent explosion of the stove."

51. For an *Improved Apparatus for Holding Music, &c.;* Andrè A. Gaget, Paris, France.

Claim.—"The construction and employment of the hooks and hold-fasts or braces, in connexion with the back, for the purpose of binding together music, manuscripts, and other loose papers."

52. For an *Improvement in Fruit Gatherers;* Firman Godwin, Astoria, New York.

"This invention consists in providing a metallic frame so formed as to serve the purpose of a rim for a bag which receives the fruit, and also to serve as a means to detach the fruit from the limbs."

Claim.—"The frame formed of the elliptical and annular rims and socket, the socket having an oblique position relatively with the frame, the outer having the bag attached, and the rim provided with the projections and openings."

53. For an *Improvement in Water-proof Soles and Heels for Boots and Shoes;* Benjamin D. Godfrey, Milford, Massachusetts.

Claim.—"The employment of a cast heel of india rubber, with an entire sole of rolled or sheet rubber."

54. For an *Improved Corn Husker;* Samuel A. Gould, Seneca Falls, New York.

Claim.—"The trip lever, in combination with the lancet-shaped knife, the guide, and the slotted lever."

55. For an *Improvement in Springs for Mattresses, Chairs, &c.;* Wm. Hersee, Buffalo, New York.

Claim.—"Supporting or maintaining the spring in a proper vertical position upon the slat, by means of the guide-pin secured within the spring by means of the head and block; the lower end of the pin being fitted and working in or through the socket in the slat."

56. For an *Improvement in Cooking Stoves;* James R. Hyde, Troy, New York.

Claim.—"The arrangement of the hot air chambers, so constructed that the air can be admitted to, or excluded from, them, entirely independent of the chamber, by means of the register, and being provided with apertures."

57. For an *Improvement in Cultivators;* David E. Hall, Abingdon, Illinois.

Claim.—"The attaching of the shares to the bars which have their back ends pivoted in the pendents, and their front ends fitted in the pendent slotted bars, which are attached to the sliding bar; the bar being operated by the treadles to give the lateral movement to the shares, and the bars used vertically by the treadles, to give them their vertical movement. Also, the cutters pivoted to the bars, and over the plates, and connected to the rods."

58. For an *Improved Machine for Turning Spiral Forms;* John C. Hintz, Cincinnati, Ohio.

Claim—"1st, In combination with the adjustable screw cutting lathe, the construction and arrangement of the gravitating frame, and concentrically and oppositely rotating cutters, whereby the latter are made to cut in unison, and always over a point in the axis of the piece. 2d, In this connexion I claim the pair of finishing bits, operated automatically by means of the screw stem, ratchet wheel, tappets, and spring pawls. 3d, In combination with the adjustable screw cutting lathe, rotary cutters, and gravitating frame, the construction and arrangement of the roller and bracket, whereby (the brace being disconnected,) the said cutters may be vibrated in a (substantially) horizontal plane at any desired angle to the stuff for the production of spiral or oblique flutings on prismatic posts."

59. For an *Improvement in Feeding Paper to Printing Presses;* Richard M. Hoe, City of New York.

"This invention relates to an improvement in that class of paper feeding devices in which the sheets of paper are fed to the machine through the agency or medium of what is termed a drop roller."

Claim.—"Giving the drop roller a constant or regular speed, corresponding at all times to that of the other running or working parts of the device, by bringing said roller when in an elevated position, and detached from the cylinder, in contact with the impelling roller, actuated by the belts or tapes."

60. For an *Improvement in Grain Drills;* Joseph Ingels, Fayette Co., Indiana.

Claim.—"In combination with the cells, the feeding blocks, vibrating in said cells, and provided with recesses for catching and forcing the grain to the exit openings."

61. For an *Improvement in Lifting Jack;* Lucius J. Knowles, Warren, Massachusetts.

Claim.—"The loose collar having a series of teeth arranged upon its inner surface, in combination with a screw head, carrying a drop clutch."

62. For an *Improved Spring Hinge;* John Maxson, De Ruyter, New York.

Claim.—"One or more springs acting against an inclined plane, curved or otherwise, with a recess at the end so arranged as to close and hold a door. Also, in combination with the above, a coiled spring so arranged as to assist the feather spring or springs."

63. For an *Improvement in Patterns for Cutting Out the "Uppers" of Boots and Shoes;* W. W. Merriam, Oswego, New York.

Claim.—"The method of operating the sliding parts of an extension pattern, so as to adjust the same not only to different sizes, but also to change the proportions of the several sizes at pleasure, without regard to the whole."

64. For an *Improvement in Fire Plugs;* Lucien Moss, Philadelphia, Pennsylvania.

Claim.—"The arrangement of fire plugs so that a gas pipe may be introduced within the metallic or other non-combustible casing surrounding the water pipe or plug proper; said gas pipe being so arranged with openings or burners, that the flame and heat produced thereby, caused by the gas flowing from them, being ignited, may be made to act upon the water pipe and cause the water therein to be thawed, if it should by accident or from neglect have become frozen; or to produce within the metallic or other non-combustible casing, a temperature that will prevent the water in the plug proper from becoming frozen during times of extreme cold."

65. For an *Improvement in Ploughing Machines;* Henry Moeser, Pittsburgh, Pa.

Claim.—"1st, The arrangement and combination of the transverse beam, connecting links, chains, driving pulleys, and wheels, or any other equivalent devices, when operating in relation to each other, and to the steam carriage. 2d, The arrangement of the guiding bar (supported on the transverse beam,) and the forks on the plough carriages, or any other arrangement, for the purpose of guiding the plough carriages."

66. For a *Machine for Cutting Bread;* James Naughten, Cincinnati, Ohio.

Claim.—"The arrangement of the swinging plate, gauge plate, and set-screw, when arranged with the spring and curved lever, for gauging the thickness of the slice of bread cut, and discharging it from the machine by the action of the lever on the curved lever."

67. For an *Improvement in Mode of Protecting Trees from Canker Worms, &c.;* Andrew T. Nute, Roxbury, Massachusetts.

Claim.—"My improved method of protecting a tree from the ascent of canker worms, the same consisting in applying finely pointed metallic wires, or one or more strips of card teeth to the same."

68. For an *Improved Lateral Feed Motion for Sawing Mills;* Kingsley R. Olmstead, Chicago, Illinois.

Claim.—"The combination of a lever and cam or eccentric, with an inclined plane, set rod, wheels, and racks."

69. For an *Improvement in Digging Ploughs;* Ezra Peck, Deer Park, New York.

Claim.—"The coulter and its horizontal shear, in combination with the cylinder of teeth."

70. For an *Improvement in Harness Buckles;* John Prendergast, Boston, Mass.

Claim.—"Forming the tongue with a recess or shoulder, in order that the strain on the tongue may be so borne by the body of the buckle, as to relieve the joint of the tongue from the strain and wear thereof, that would result therefrom."

71. For an *Improved Signal Lantern;* John R. Pierce and Leavitt B. Austin, Oswego, New York.

Claim.—"The combination of a traversing chimney and lamp, so arranged as to avoid the bad effect of the lamp's smoke in signal lanterns."

72. For an *Improvement in Seeding Machines;* Ephraim Russell, Coatesville, Penna.

Claim.—"1st, The combination of the screw friction clutch with the cam wheel. 2d, The adjustable jointed conveyer spouts."

73. For an *Improvement in Mode of Protecting Trees from Canker Worms, &c.;* Philip C. Rowe, Boston, Massachusetts.

Claim.—"My improved tree protector, made with the encircling roof or cover of metal, or other suitable material, and one or more circular or surrounding fringes, suspended from the said roof and around the tree."

74. For an *Improvement in Sewing Machines;* E. Harry Smith, City of New York.

"This invention consists in a new construction of what is known as the discordal shuttle of sewing machines."

Claim.—"The discordal shuttle, made to control the loop of needle thread."

75. For an *Improvement in Candlesticks;* James Spratt, Cincinnati, Ohio.

"My invention consists in a provision for the convenient and effectual securing of a mould candle to the candlestick, the taper form of the candle itself being made available for this purpose."

Claim.—"The method of securing a candle by the conical ferrule, adapted within, to be drawn over the candle, and tightly clasp its butt, and screwed, or otherwise attached, to the sconce."

76. For an *Improved Husking Palm;* David E. Shaw, Ross Co., Ohio.

"My husking palm is constructed in such a manner as to be used on the palm of the hand, and is so adapted to the hand, as to be entirely free from the danger of making the hands sore from its use."

Claim.—"The husking palm, to be used on the palm of the hand for husking and breaking off the butts of corn."

77. For an *Improved Instrument for Surveying and Calculating Areas;* James M. Lilley, Greenville, Virginia.

Claim.—"The combination of the three scales and quadrant."

78. For an *Improvement in Ploughs;* Horatio Stanley, Erie Co., Pennsylvania.

Claim.—"The construction of the plough frame with the rollers, and so constructed that any number may be attached to the same axle-tree by means of the frame."

79. For an *Improvement in Grinding Mill;* Charles Tripp, Ann Arbor, Michigan.

"My invention consists in the employment or use of a grinding burr or stone, in combination with adjustable rests, whereby articles or substances may be ground very rapidly by very simple means."

Claim.—"The adjustable rests, placed between the projections and the plate, and provided with the discharge throats, in combination with the burr."

80. For an *Improvement in Window Sash;* Francis Thrasher and Henry B. Horton, Akron, Ohio.

Claim.—"The locking friction strip, for the purpose of raising the window with ease, and sustaining it at any height."

81. For an *Improvement in Clamp for Centering Hubs for Boring;* John Thrasher, Avon, New York.

Claim.—"The combination of the vibrating arms, link, and screw, for the purpose of centering and holding the hub while it is being reamed, or bored and reamed."

82. For an *Improvement in Generating Anhydrous Steam;* Wm. Mt. Storm, City of New York.

Claim.—"The arrangement of means for rendering steam anhydrous, without the exposure of the tubes or drying vessel to the direct action of the fire or hot products of combustion."

83. For an *Improvement in Last Holders;* A. J. Tewksbury, Haverhill, Mass.

Claim.—"The ball and socket joint, in combination with the spring bolts."

84. For an *Improvement in Revolving Snow Excavators for Railroads;* Jesse Urmy, Wilmington, Delaware.

"My invention is designed for use in heavy snow drifts, for cleaning snow from railroad tracks."

Claim.—"1st, The obliquely set-side paddle-wheels, whose axes lie in a plane vertical to, and at right angles with, the track, and diverge downwards from a point over the centre of the track, and whose arms radiating in a plane at right angles with said axes, have upon their extremities, edged or toothed paddles, so arranged that each one shall, when at the lowest point of the plane in which it revolves, be in a horizontal plane, and oblique to the rail of the track. 2d, The central paddle-wheel, revolving in a vertical plane at right angles with the track, in combination with the obliquely set-side paddle-wheels."

85. For an *Improved Bullet Machine;* Wm. H. Ward, Auburn, New York.

Claim.—"1st, Arranging the feeding clamp and mechanism for operating it, in such a manner that the limit of the backward motion remains unchanged, while the forward motion is regulated by the amount of wire required to form the blank. 2d, The combination of the adjustable stop, the wire, and the mechanism for carrying the wire forward, for the purpose of regulating the length of the feed without changing the limit of the backward motion of the feeding mechanism. 3d, The method of regulating the size and density of each blank before it is severed from the wire, by means of a pair of compressing forceps, or their equivalent. 4th, The employment of two pairs of cutting and grasping forceps, or their equivalent, for dividing the wire, so arranged and operated as to grasp the wire, and sever it between their adjacent faces. 5th, The combination of the oil box with the cutting forceps. 6th, The combination of the discharging collar with the punch, and the mechanism for opening the dies, for the purpose of releasing the bullet from the dies, and discharging it from the machine. 7th, Arranging the joint between the two pairs of forceps, so as not to be in the same plane. 8th, Arranging the groove around the cavity in the die, so as to allow the air to escape from the die, and prevent the passage of the lead into the groove. 9th, Making the opening in the die of less diameter than the base of the bullet, and of the exact size of the blank. 10th, The method of gauging the blank and forming the base of the bullet, by means of an annular projection in the base of the die. 11th, The method of forming bullets of variable weight, and of the same external form, with the same set of dies and punches, by constructing the die with a projecting annular base, so that the punch can be entered into the blank a greater or less distance, and thus expand the recess in the base of the blank, so that it will accurately fill the die, and thus form a perfect bullet."

86. For an *Improved Horse Shoe Nail Machine;* John Wooton, Boonton, N. J.

Claim.—"1st, The employment of the nail rod itself as a ratchet, constituting part of a ratchet motion, by which it is fed longitudinally to the machine, thereby insuring infallibly a proper length of feed, and dispensing with the necessity of gauges to regulate the feed movement. 2d, Giving to the punching apparatus a motion laterally to the nail rod, in addition to the longitudinal movement of the rod, so as to produce a combined longitudinal and lateral feed motion."

87. For an *Improvement in Printing Presses;* Stephen Wilcox, Jr., Westerly, Rhode Island.

Claim.—"The adaptation of the eccentric segment to the stationary bed, when said segment is held to the bed by radius bars. Also, the elastic fly bending round the platen."

88. For an *Improvement in Sub-soil Ploughs;* Reuben North and John Wood, Rochester, Wisconsin.

Claim.—"The combination of the auxiliary or sub-soil share and its adjustable standard, with the adjusting lever and its attachments, when the whole is constructed and arranged in relation to the main share and beam."

89. For an *Improvement in Machinery for Dressing Warps;* Samuel Campbell, Whitetown, New York, Assignor to John C. Whittier, Northbridge, Massachusetts.

Claim.—"The method of dressing warps, by means of brushes above and below each section of yarn, said brushes being alternate in their movement, and constructed to come in contact with, and leave the yarn gradually by, the mechanism described."

90. For an *Improvement in Quilting Frames;* Herman N. Dewey, Assignor to B. L. Hill & Co., Berlin Heights, Ohio.

Claim.—"The vertically adjustable arms, having spring jaws for adjusting the bars."

91. For an *Improvement in Lard Rendering Kettles;* Allen Lapham, Assignor to self and Joseph G. Bennett, Brooklyn, New York.

Claim.—"In combination with a steam kettle, a hollow steam cylinder supported upon pipes, whereby I am enabled to concentrate a great heat upon the material rendering, thereby saving fuel, and making the kettle easy of access, for the purpose of cleaning."

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92. For an *Improved Apparatus for Ringing Bells;* James R. Baird, Vergennes, Indiana.

Claim.—"The direct attachment of the circular lever to the ball or lower end of the tongue or clapper, and the combination of said lever, thus attached, with the vibrating cross-head and handle, by means of the pendulous rods."

93. For an *Improvement in Straw Cutters;* Jesse Ball, Barnesville, Ohio.

Claim.—"The reciprocating rack, operated from the knife frame through the medium of the lever, projection, and bent lever, in combination with the compress, adjustable and pressure lid, and stationary rack."

94. For an *Improved Device for Husking Corn;* David Bedell, Seneca Falls, N. Y.

Claim.—"The knife attached to bar, in combination with bar attached to spring and rod, attached to said spring by means of the lever and link, the whole being arranged to operate conjointly."

95. For an *Improved Device in Telegraphic Fire Alarm Apparatus;* Edward C. Clay, Boston, Massachusetts.

Claim.—"The snail, or its equivalent, and dial plate, in combination with single key."

96. For an *Improved Elastic Door Guard;* Wm. N. Clark, Chester, Connecticut.

"My invention consists of an elastic door guard, neat, or even elegant in appearance, and forming a perfect protection against all damage and noise arising from the swinging of the door in opening."

Claim.—"The elastic door guard."

97. For an *Improved Harvesting Machine;* John C. Cox and Reuben Newton, Greenville, North Carolina.

Claim.—"The comb, in combination with the rotating teeth and roller."

98. For an *Improved Brick Machine;* John B. Collen, Philadelphia, Pennsylvania.

Claim.—"The perforated plates, operating in combination with the inclined plate or apron."

99. For an *Improvement in India Rubber Springs for Upholstery purposes;* Francis Colton, City of New York.

Claim.—"The form and combination of a vulcanized india rubber ring, with the steadying post, together with the application of the same."

100. For an *Improved Carpet Fastener;* Stephen Culver, New Jersey.

Claim.—"The method of securing carpets to floors, by means and use of a metallic plate attached to the underside of the carpet, perforated to receive the head of a screw, and by such perforation hitched to a screw, or its equivalent, driven into the floor, so that the carpets may be put down and taken up at pleasure without the use of tools."

101. For an *Improved Clothes' Clamp;* Lewis H. Cushman, Monmouth, Maine.

Claim.—"The combination of the spring and cam lever."

102. For an *Improved Washing Machine;* Alexander Dickson, Hillsboro', N. C.

"This invention consists in using pumps, whereby in addition to the usual friction to which the cutters are subjected, the water is forced through them, and the clothes thereby cleansed more thoroughly and expeditiously than usual."

Claim.—"The combination of the oscillating rubber, stationary bed, and pumps, arranged to operate conjointly."

103. For an *Improvement in Breech Loading Fire Arms;* J. Durell Greene, Cambridge, Massachusetts.

Claim.—"1st, The groove, or its equivalent, operating in connexion with the wad at the rear of the cartridge. 2d, The sliding breech plug, in combination with the revolving plunger. 3d, The bolt and stop, to interrupt the movement of the trigger."

104. For an *Improvement in Lime-kilns;* Powell Griscom and Charles S. Denn, Baltimore, Maryland.

Claim.—"The peculiar combination and arrangement of the parts."

105. For an *Improvement in Extension Tables;* Henry Gross, Tiffin, Ohio.

Claim.—"The combination of the two systems of stretchers, with the stay-rods."

106. For an *Improvement in Flour Distributing Bolt for Grinding Mill;* W. W. Hamer, Cincinnati, Ohio.

Claim.—"The exact combined arrangement of the conveyers, and their compartments, when united together with the openings."

107. For an *Improved Hemp Cutter;* John L. Hardeman, Arrow Rock, Missouri.

Claim.—"1st, The hinged trailing hemp platforms, approximating in form to a right angle triangle, and made with an inclined elevation and guard, and arranged in rear of the cutter beam on both sides of the machine, in such a manner that a broad central space shall be left for the cut hemp to be laid in out of the way of the team and the body of the machine by said platforms. 2d, The employment of the peculiarly constructed hemp trailing platform, in combination with the inwardly inclining beveled directing board, arranged just above the trailing platform, for the purpose of directing the hemp angularly upon the platform. 3d, The employment of a reel having its blades bent spirally at one end to their axle or shaft, in combination with the inwardly inclining directing board or boards, and trailing platform or platforms."

108. For an *Improvement in Sewing Machines;* N. W. Warrington, Jamestown, New York.

"This invention consists in a looper of novel construction, operating in combination with an eye pointed needle, to sew what is known as the chain stitch, with a single thread."

Claim.—"The looper composed of three fingers, arranged and operating together in combination with the needle."

109. For an *Improved Mode of Operating Fly-frames of Printing Presses;* Richard M. Hoe, City of New York.

"This invention relates to an improvement in the manner of operating the fly-frames of printing presses, and is mainly applicable to the frames used on my type revolving printing machine."

Claim.—"Operating the fly-frames by means of the cam shafts placed at each end of the machine, and provided with cams, and used in connexion with arms, rods, arms, and springs, or an equivalent device, whereby the cams are made to actuate the fly-frames in a more direct manner, and consequently insuring a more perfect operation of the same."

110. For an *Improved Mechanism for Operating Pilots' Bells on Steamers;* J. R. Hopkins, Lincoln, Assignor to self and G. T. Sargent, Bangor, Maine.

Claim.—"1st, The arrangement of the knob and slotted plate, so that the several orders may be transmitted to the engineer or the cylinder rotated as desired to present such orders, by moving one and the same knob in different directions. 2d, The bars, levers, provided with pins, plates, segment rack, pinion, and rods, on the shaft. 3d, The employment or use of the two levers, provided with bell hammers, and operated by means of the bar attached to plate, and provided with springs and the plate, the bar and plate being provided respectively with the projections or shoulders."

111. For an *Improved Washing Machine;* Abraham Huffer, Hagerstown, Maryland.

Claim.—"The combination of the shallow concave formed of rollers and feeding boards, with the ribbed cylinder, for the purpose of making the washing machine self-feeding and self-clearing, so as to pass the clothes alternately into the water and the air, thus bleaching as well as cleansing them, and keeping the clothes in the upper strata of water away from the dirt, which is precipitated to the bottom of the tub."

112. For an *Improvement in Portable Forge;* W. G. Hyndman, Cincinnati, Ohio.

Claim.—"The plate, when arranged with the bottom of the hearth plate, by which arrangement of plates the recess is formed, and to be filled with fire brick, or any other good non-conducting material to serve as a hearth to the forge, in place of laying the brick on the top of the hearth plate, for reasons mentioned."

113. For an *Improved Corn Husker;* Charles N. Lewis, Seneca Falls, New York.

Claim.—"The combination of the operating lever, with the wedge-pointed dog, lever, tripping post, blade, concave, and slot."

114. For an *Improvement in Pitchers for Molasses, &c.;* Edward Mingay, Boston, Massachusetts.

Claim.—"The means employed to prevent the dripping of liquids in pitchers for containing liquids, the same consisting of the movable spout or jaw actuated by the opening or closing of the cover, so as to raise and lower the said spout or jaw."

115. For an *Improved Machine for Turning Wooden Boxes;* Alexander S. Newton, Brandon, Vermont.

Claim.—"1st, The use of the combination of the grooved rod and bevel wheel on the end thereof, with the wheel and cam. 2d, The use and combination of the grooved rod and bevel wheel on the end thereof, with the wheel and cams. 3d, The use and combination of the cam with the lever, cutter lever, and discharging bar, or their equivalents, separately or collectively. 4th, The cam, in combination with the lever and rack, or equivalents, for the said parts."

116. For an *Improved Machine for Turning Pillars for Clock Movements;* Willford H. Nettleton, Charles Raymond, and Anson Hatch, Assignors to W. H. Nettleton, Bristol, Connecticut.

Claim.—"The feeding slide, in combination with the straightener, having an endwise movement and returning spring, or its equivalent, whereby the straightener is drawn along as the wire is fed forward, and straightens the wire as it is forced back by the said spring, or its equivalent. Also, the compound levers, made and acting in connexion with the feeding slide and clamp. Also, the holding jaws, regulated in their action by the screws. Also, the sliding gauge, actuated by the cam, in combination with the holding jaws, whereby the gauge is withdrawn while the pillar or arbor is being forced out of said holding jaws, but comes up to determine the length or position of the wire or blank that passes into said jaws."

117. For an *Improved Cake Cutter;* George R. Peckham, Worcester, Massachusetts.

Claim.—"The movable cutter, with its head being placed in the socket, and its capability of being reversed in its position."

118. For an *Improved Gas Metre Indicator;* Thomas I. Pitt, City of New York.

"The object of my invention is to render an indicator a cheap, simple, compact instrument, by means of a rotary dial worked by endless screws, which derive their motion from the drum of the metre."

Claim.—"The employment of a rotary indicator applied to gas metres, to register the consumption of gas."

119. For an *Improved Butter Worker;* Isaac L. Smith, Burlington, Vermont, and Chas. C. Colburn, Massena, New York.

Claim.—"The box hinged to a sliding frame, and made capable of adjustment to any desired extent, without being thrown out of gear."

120. For an *Improved Fastening for Machine Belting;* Lewis Smith, Buffalo, N. Y.

Claim.—"A series of curved arms with faced end fingers extending from a bar on either side, and at right angles thereto, composed of one entire piece of metal, being a new article of manufacture, and constituting a belt clasp to be used in joining the two ends of belts in running machinery."

121. For an *Improved Method of Adjusting Band Saws to Circular Stocks;* Jacob Vaughan, Exchangeville, Pennsylvania.

Claim.—"Securing the saws to the wheel, by means of the expanding and contracting bands, whereby every part of the saws are firmly secured to said wheel, without perforating the saw or making use of intermediate bolts and screws."

122. For an *Improvement in Self-feeding Drills;* Wm. Wakely, Homer, New York.

Claim.—"The arrangement of the gearing whereby both pinions may be operated at the same time, so that the drill may be rotated and fed to its work by the rotation of a single shaft or crank. Also, the arrangement of the lever with the shaft and catch, in connexion with the rod and cross-head with the pins attached, for the purpose of connecting the wheel – with the wheel, – and disconnecting it therefrom."

123. For an *Improvement in Tooth Brushes;* H. Nichols Wadsworth, Washington, District of Columbia.

Claim.—"A tooth brush having all the features combined and arranged as set forth."

124. For an *Improved Key for Door Locks;* Thomas K. Webster, Lawrence, Mass.

Claim.—"The mode of making the key, that is, with its shank and bit in two parts, applied together and combined with, and containing lever bits, a cam, slider, and spring, or the equivalents therefor, such lever bits, while the key is being turned back in the lock, being made to actuate or force outward the catch levers, applied to the bolt and its case, and combined and operating therewith."

125. For an *Improvement in Steam Pressure Gauges;* John E. Wooten, Philadelphia, Pennsylvania.

Claim.—"The combined arrangement of the duplicate elastic metallic disks with the bars, for the purpose of giving motion to the index."

126. For an *Improved Machine for Facilitating the Husking of Corn;* George Young, Jr., Saratoga Springs, New York.

Claim.—"The combination of the respective actuating parts of my machine, whereby the latch, the knife, and the hammer will act in conjunction with each other."

127. For an *Improvement in Hemp Brakes;* George F. S. Zimmerman and Armstrong Beattie, St. Joseph, Missouri.

Claim.—"The arrangement and operation of the feed rollers, scutching rollers, and breaking cylinder, whereby the hemp is stretched between the feed rollers and breaking cylinder, and also between the latter and the scutching rollers, the material while thus stretched being acted upon by the breaking cylinder and the scutching rollers."

128. For an *Improved Corn Husker;* Herman A. Doster, Bethlehem, Penna., Assignor to self and Smith A. Skinner, Lowell, Massachusetts.

Claim.—"The rollers, when provided with the grooves and teeth."

129. For an *Improved Cutting Apparatus for Harvesters;* James L. Fountain, Assignor to self, L. J. Clark, Bradford McKinney, and C. M. Fountain, Rockford, Illinois.

Claim.—"The fingers, in combination with the horns or projections, reciprocating sectional cutters, and clearing rivets, the whole constructed and arranged for joint operation."

130. For an *Improved Ventilating Attachment to be Applied to Pumps;* Charles N. Lewis, Assignor to self and G. C. King, Seneca Falls, New York.

"This invention has for its object the allowing of a free access of air to the well, for the purpose of ventilation, and at the same time preventing dirt, rain, waste water, and foreign substances generally from passing therein."

Claim.—"The arrangement and combination of the perforated base, cap, and perforated tube, with the pump barrel, whereby the ventilator becomes attached to, and forms a part of, the pump."

131. For an *Improved Corn Husker;* Smith A. Skinner, Lawrence, Mass., Assignor to self and Herman A. Doster, Bethlehem, Pennsylvania.

Claim.—"The arrangement of teeth in one roller, in combination with the arrangement of the grooves entirely in the other roller, the same serving to effect the rotation of the ear of corn, as well as the removal of the husk and its presentation to the bite of the rollers."

132. For an *Improvement in Steering Apparatus;* T. M. Richardson, Assignor to self and I. W. Havner, Searsport, Maine.

Claim.—"The combination and arrangement of the rope or chain, with the stationary grooved sheaves, and the grooved pulley."

133. For an *Improvement in Street Sweeping Machines;* David Shattuck, Assignor to self, John S. Shattuck, Jacob Morrill, and Wm. P. Marshall, Boston, Mass.

Claim.—"The arrangement of the cam beneath the horizontal arms or brush carriers, whereby the dirt may be thrown to either side or centre of the street."

134. For an *Improvement in Calendar Clocks;* Wm. H. Akins, Berkshire, and Joseph C. Burritt, Assignors to Wait F. Huntington and Hervey Platts, Ithaca, New York.

Claim.—"The quadrennially revolving corrugated disk."

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135. For an *Improvement in Machines for Covering Sugar Cane;* John Allison, St. Martinsville, Louisiana.

Claim.—"The boards provided with the blades and revolving harrows, in combination with roller."

136. For an *Improvement in Slide Valves for Steam Engines;* Nathan Atherton, Philadelphia, Pennsylvania.

Claim.—"The construction of the slide valve with curved edges, arranged with such a lap over the faces of the steam chest, that the steam shall be admitted in front of the piston an instant before the stroke has been completed, and so that the exhaust shall not be made behind the piston until after the stroke has been entirely completed."

137. For an *Improvement in the Preparation of Engraved Metal Plates for Printing;* John M. Batchelder, Cambridge, Mass., and Luther L. Smith, City of New York.

"This improvement has for its object the hardening of the surface of copper plates, in order that as many impressions may be taken from them as from the steel, and also to facilitate the wiping or cleaning of the plate after it is inked."

Claim.—"An engraved plate composed of two metals, one of which is iridium, and forms the face or impression surface of the plate, the other metal forming the back of the plate, being copper, or any metal that can be engraved with the common tools used by engravers, while the printing surface produced is very hard, and will give a greater number of impressions than the engraved plates now in use."

138. For an *Improvement in Screwing Tubes in Vacuum Pans;* Barnabas H. Bartol, Philadelphia, Pennsylvania.

Claim.—"The making of the tubes many sided in their interior parts, so that by the use of a many sided long mandrel fitting into said interior, they may be placed, removed, or replaced, without the necessity of having the ends of said tubes project beyond the tube sheets."

139. For an *Improvement in Hay and Manure Forks;* G. L. Barton and A. E. Roberts, Albany, New York.

"Our invention consists in the peculiar construction of the implement, whereby the

principal parts of the fork may be constructed of wood, and a light, durable, and cheap implement obtained."

Claim.—"A hay fork provided with an upright bow, said bow being firmly held in its position by means of the rod, which rod extends from the centre of the tines to the centre of the bow, and thence to the handle of the fork, the tines being provided with double cross-bars."

140. For an *Improved Churn;* Lewis W. Beecher, Avon, New York.

Claim.—"The swing valves or beaters, operating and producing the effects set forth."

141. For an *Improved Ore Separator;* Wm. O. Bourne, City of New York.

Claim.—"The arrangement of a rake with scrapers alternating and revolving over a body of ore upon a sieve. Also, the arrangement of the tub with the bellows below the sieve, in relation to each other."

142. For an *Improvement in Piano-Fortes,* Stephen P. Brooks, Boston, Massachusetts.

"This invention consists, first, in combining and arranging the damper and hammer of each key of the action in one bent lever, operated by a fly or lifter. 2d, In a peculiar arrangement of the fly-lifter and escapement or mechanism extending between the jack and hammer."

Claim.—"Combining or arranging the hammer and damper of each string, in or on one bent lever. Also, jointing or hinging the fly or fly-lifter to the hammer lever, and arranging the escapement on the jack, the same dispensing with hinging the fly to the jack, and enabling the fly and lifter to be made or united in one rigid bar or piece. Also, the arrangement of the back-catch, viz: on the jack and in rear of the escapement."

143. For an *Application of Hot Water to Journals of Rolling Mills;* John Bryan, Covington, Kentucky; patented in England, September 4, 1857.

"The object of my improvement is to keep the journals of the rolls as near as possible the same temperature as the body of the rolls, when rolling metal in a heated state, without rendering the rolls liable to break."

Claim.—"Equalizing the temperature of rollers and their journals that are used in rolling hot iron, or other heated work, by means of hot water applied to said journals, for the purpose of making the fibre of the metal of which the rolls and journals are made more uniform at their point of junction, and thus lessen the liability of their breaking or separating at that point."

144. For an *Improved Arithmometer for Adding;* O. L. Castle, Upper Alton, Ill.

Claim.—"1st, The combination of the repeater, the stationary repeater stop, the sliding stop bars, and the stationary stop-pin, with the driving-wheel, or its equivalent, provided with a series of holes, the whole operating to control the motion of the register. 2d, Combining the shaft of the driving-wheel, or its equivalent, with the keys, by means of a stronger spring and a weaker spring, and a lever, deriving motion from the keys. 3d, Combining the keys with the sliding stop bars, by means of the wedges attached to the keys, the arms sliding on guide bars, and the collars and springs applied to the guide bars. 4th, The loose teeth applied to the wheels."

145. For an *Improvement in Couplings for Melodeons, &c.;* E. B. Carpenter, Brattleboro', and E. N. Merriam, East Poultney, Vermont.

"This invention relates to certain mechanism which is employed to combine the valves with the keys, in such a manner that any given tone and its octave, with the fifth or tenth, or both of these combined, or any other intervals that may be desired on the same key-board, may be played at one and the same time, by pressing a single key."

Claim.—"1st, The employment of a single series of diagonal levers, arranged relatively to, and combined with, the keys by blocks and jacks, whereby a single lever serves not only to couple a key with another to which it stands in the relation of octave, but with other keys to which it stands in different relations as fifths, tenths, &c. 2d, Supporting the diagonal levers upon a fulcrum board that is arranged between the keys and valves, and applied so as to be capable of rising towards, and falling from, the keys with the whole series of levers. 3d, Combining the jacks with the uncoupling bars, by means of the elastic connexions."

146. For an *Improvement in Metallic Roofing for Subterranean Vaults;* John B. Cornell, City of New York.

Claim.—"My improved metallic roofing for an apartment located under a side walk,

and a portion of a street carriage way; the said roofing being constructed of the metallic beams, the metallic sectional plates, and the metallic plate, in such a manner that the united inner surfaces of the said parts form the ceiling to said apartment, at the same time that the sectional plates form an illuminating water tight street side walk, and the plate forms a safe support for the portion of the carriage way immediately over said apartment. Also, the arrangement of my improved metallic roofing for subterranean apartments, which enables the beam to serve as the main support of said roof, at the same time that the exposed portion thereof forms the street curb."

147. For an *Improvement in Many-chambered Rotating Fire Arms;* Samuel Colt, Hartford, Connecticut.

"My invention consists in securing the rotating breech in place, by a central pin inserted from behind through a hole in the shield plate, so that the pin can be readily taken out and put in to remove the breech and replace it, without the necessity of taking off the barrel, as was the case prior to my invention."

Claim.—"Securing the many-chambered rotating breech in place by a solid pin passing through the central bore thereof, and fitted to a hole in the breech plate, behind, and in a line below the bore of the barrel, so as to be inserted from the rear end, and there secured, that the breech may be properly and conveniently inserted within a cavity in the surrounding metallic frame, which connects the barrel with the shield plate, to give the required strength and support to resist the recoil, the main part of the said breech being thus placed below the barrel by an arrangement as described. Also, the adjusting of the rotating breech to the rear end of the barrel by combining therewith, and with the central pin on which it turns, a hollow screw tapped into the shield plate, and bearing against the rear end of the rotating breech."

148. For an *Improved Machine for Cutting Shingles from the Bolt;* Elisha K. Collins, Cambridge, Massachusetts.

Claim.—"The combination of the two screw-shafts and knives, arranged relatively with each other and with the bolt."

149. For an *Improved Spoke Machine;* George W. Cooke, Springfield, New Jersey.

Claim.—"The planing of spokes with rotary cutters whose surface or circumference is divided by grooves, the edges thereby being in sections or teeth, the same acting alternately on the work, in combination with lever, springs, and cog-screws, for the purpose of producing the lateral and oblique movements of the cutters."

150. For an *Improved Shingle Machine;* James Crary, Kittaning, Pennsylvania.

Claim.—"The use of the sliding side pieces with converging slots, in combination with the upright grooves in the frame in which the wrists of the shaving knife are inserted, for the purpose of effecting the gradual approximation of the shaving knives in giving the proper taper to the shingles. Also, the combination of the lever with its pin, the projecting cam, and cam on the frame, for the purpose of communicating the requisite relative motion to the vibrating feed board, the driver, and frame, whereby one bolt only at a time of the three riven by the frocs is driven outwards and forced through the shaving knives, no matter how short or thin the bolt may have been froed."

151. For an *Improvement in Ploughs;* James G. Cummings, Columbus, Mississippi.

Claim.—"The mode of making the plough standard to carry the variety of cutters and mould boards, the same consisting in the expansion of the standard at the point, in combination with the groove in the nose of the plough. Also, the compound adjustment of the mould-board by the three set-screws, operating upon the heel of the land side."

152. For an *Improvement in Means for Stopping and Starting Ferry Boats;* Joseph C. Day, Jersey City, New Jersey.

Claim.—"The elastic shields, constructed and applied to the slip. Also, the arrangement of the pistons or buffers, grapple, and shields, operating together."

153. For an *Improved Machine for Filing Saws;* Jacob Erdle, West Bloomfield, New York.

Claim.—"1st, The two adjustable or elastic bars, attached one to the permanent bar, and the other to the bar of the clamp, whereby the movement of the saw may be fed to

the file in a horizontal or curved direction corresponding to the form of its cutting edge, or to the line of its teeth. 2d, Placing the file bar within the frame pivoted or hung, so that the position of the file may be changed relatively with the saw. 3d, The arrangement of the lever, pawls, and wheel, provided with ratchet teeth, and the pinion and rack, whereby the saw is fed to the file in either direction."

154. For an *Improvement in Skates;* Stockton H. Evans and Ludwig Gentsch, Philadelphia, Pennsylvania.

Claim.—"The spurs, or their equivalents, in combination with the inclined rotating spur or cam, which presses the heel against the spurs, and locks it down to the skate. Also, the adjustable plate over the fore part of the skate, for the purpose of adjusting and tightening the straps over the top of the foot."

155. For an *Improvement in Harvester Rakes;* Elias T. Ford, Batavia, New York.

Claim.—"The gathering arms, in combination with the spring platform, grain divider, and gavel remover, the whole being arranged in relation to, and operated by, the rock shaft and cam."

156. For an *Improvement in Machines for Slating Coal;* Jacob Gass, Assignor to self and George Mowton, Trevorton, Pennsylvania.

Claim.—"The employment in the process of slating coal of the revolving inclined cylinder, when constructed with the several peculiar features for united use, to wit:—checkered circumferentially near the centre of its length with small square openings, furnished with narrow oblong slots from its receiving end to the checkering, and with similar but wider slots from the discharge end to the checkering end, each or every other one of its slats furnished with a beveled or V shaped rib, internally, which only extends from the checkering to the ends of the cylinder."

157. For an *Improvement in Measuring Apparatus of Seed Drills;* Oliver C. Green, Dublin, Indiana.

Claim.—"The construction and arrangement of the sheath and the slide, provided with passages, operating in combination with the seed box of a grain drill."

158. For an *Improved Leveling Instrument for Ditching, &c.;* Joseph Gray, Raymond, Mississippi.

"My instrument is chiefly designed to be used in agricultural operations, to aid in marking out the lines for ploughing ditches and furrows on hill sides or undulating ground."

Claim.—"The combination of the two adjustable bars, provided with graduated sectors, with the table and bar, or other equivalent support, capable of being adjusted in a level position, for the purpose of laying out levels or grades in a direction transverse to the line of vision."

159. For an *Improvement in Seed Drills;* Philip M. Gundlach, Belleville, Illinois.

Claim.—"The arrangement consisting of a variable vibrating slotted slide, vertical adjustable plate, with a series of overhanging guards, and downward projecting gauge spurs, and perforated hopper, for united operation. Also, the arrangement of a series of radial arms in spiral lines, directly upon the propelling axle, and of said axle and arms behind the seed tubes, and in such relation to the same, that the arms pass successively between the lower extremities of the tubes."

160. For an *Improvement in Method of Floating Horses, &c., Across Rivers;* Samuel P. Heintzelman, Newport Barracks, Kentucky.

Claim.—"The specific form of cavalry float, consisting mainly of a pair of bags connected by girths, and provided with the fastening straps, the bags having each the form of two lobes connected by a duct, and being provided with suitable inflation tubes."

161. For an *Improved Arithmometer;* Thomas Hill, Waltham, Massachusetts.

Claim.—"1st, The use in a mechanical calculator of the series of wheels, having each a double row of characters. 2d, Operating the said wheels by the keys, the levers, and pawls, or their equivalents. 3d, The wheel, in combination with the arms and pawl."

162. For an *Improvement in Boilers for Heating Buildings;* Anthony E. Hitchings, City of New York.

Claim.—"The arrangement within the upright conical water jacket, of the upright

flat-sided central water chamber, extending nearly across the said jacket in one direction, but made narrow in a transverse direction."

163. For an *Improvement in Attaching Paddle-wheels to Canal Boats;* Reuben Jane, Otego, New York.

Claim.—"The vertical slotted shaft, hung on a pivot on the bow of the boat, arranged in relation to the wheel shaft, to which is attached the twisted paddles for the purpose of drawing boats on canals, which are put in motion by the engine by means of gear wheel."

164. For an *Improved Washing Machine;* John D. Jenkins, Jacksonville, Illinois.

Claim.—"The arranging relatively to each other for united use of the rubber frame, rubbers, roller, connecting rods, crank shaft, overhanging spring bracket, roller bed, and variable discharge roller."

165. For an *Improvement in Ventilating Rocking Chairs;* David Kahnweiler, Wilmington, North Carolina.

Claim.—"Combining a refrigerating apparatus with a rocking chair."

166. For an *Improvement in Bean Harvesters;* Joshua Ketcham and John Waterman, Orangeport, New York.

"This invention consists in certain devices for snaring and gathering beans from the vine."

Claim.—"The slide for the purpose of pulling and dislocating the beans, and carrying them away over the head, and this slide, in combination with rollers and levers, operated by means of lever, rod, and handle, for the purpose of forming a bean harvester."

167. For an *Improvement in Gang Ploughs;* Joel Lee, Galesburgh, Illinois.

Claim.—"The peculiar arrangement, consisting of friction wheels, inclined planes, and lever, for adjusting the plough frame to any required position. Also, the peculiar arrangement consisting of the flanch or guard and pivoted axle, for allowing the turning of the front truck to a position at right angles, or nearly so, to the hind truck, so that the machine may turn a square corner without liability of lifting the plough shares out of the ground."

168. For an *Improved Painters' Striping Instrument;* James J. McCormick, City of New York, and George Crossingham, Croton Falls, New York.

"This invention consists in the employment or use of a feeding device in connexion with a pen of peculiar construction, and a pump or cylinder and piston."

Claim.—"The feeders, in combination with the pen, cylinder, and plunger."

169. For an *Improvement in Corn Shellers;* John W. Morton, Brunswick, Ohio.

Claim.—"The driving of both the exit rollers in opposite directions, by means of the endless screw, or its equivalent, operating upon the gear; the opposite end of one roller shaft being made adjustable by the step and the spring for the purpose of seizing the cob, whether large or small, and delivering it from the machine."

170. For an *Improved Pendulum Quadrant;* Robert Norris and Frederick Peters, City of New York.

Claim.—"The pendulum with its tell-tale, in combination with the index, the sight tube, and the other parts of the quadrant."

171. For an *Improvement in Shelving for Curing and Storing Cheese;* Jeremiah H. Phillips, Colebrook, Ohio.

Claim.—"The short movable shelves with the rabbeted or beveled ends thereof, combined and operating with the fixed cheese shelves."

172. For an *Improved Arrangement in Sash Balance;* Joseph R. Payson, Covington, Kentucky.

"This invention consists in the arrangement of the cords, pulleys, and balanced sashes, combined with, and operated by, a weight or weights equal to the aggregate weight of both sashes; the weight or weights being arranged upon the inside of the window, without box or boxes."

Claim.—"Combining the arrangement of cord and pulleys, attached to the sides of

balanced sashes and frame, with the arrangement of the open weight or weighted tassel, by which means the sashes can be diversely operated in counterbalance with the weight conjointly and separately, by which means is furnished to the trade and the public a new, economical, and useful mode of counterbalancing sashes without one-fourth of the usual weight, and in the common plain frame without boxes, after the building is finished, without change in the frame or injury to the finish."

173. For an *Improvement in Safety Lamps;* Wm. Pratt, Baltimore, Maryland.

Claim.—"Protecting the orifices of vessels used in holding, pouring, and burning inflammable liquids, with a volute of ribbed metal wound upon itself, or made of strips of plain and corrugated metal wound together; these so formed making most economically a series of regular tubes of great stability and conducting power, together with freedom of pouring through them the liquids used; and also presenting great facility of cleansing from any accidental obstructions. Also, the arrangement of the feeder tube and cap, and the wick tubes and cap, either by the intersection of the peripheries or stops suitably placed, in such a manner that the removal of the wick cap cannot take place till that which covers the protected orifice for replenishing the lamp is first taken off."

174. For an *Improvement in Pump Packing;* Washburn Race, Seneca Falls, N. Y.

Claim.—"Causing the wedge-piece, which holds the two lower valves in place, to serve also in combination with said piece, as a packing for the oscillating shaft."

175. For an *Improved Machine for Making Cigar Lighters;* Henrich Reimann, Hartford, Connecticut.

Claim.—"The arrangement of the mechanism."

176. For an *Improved Projectile for Fire Arms;* John B. Read, Tuscaloosa, Ala.

Claim.—"The surrounding of the cylindrical portion of elongated projectiles, with a band of lead or other fusible metal or alloy, filling a recess, with projections or lugs in the same to prevent its displacement, and provided with one or more vents extending from the rear of the projectiles to the inner side of said band, for the purpose of expanding it by the gases of fired gunpowder, so as to save windage and secure rotation by taking into rifle grooves."

177. For an *Improvement in Trusses;* J. W. Riggs, Plainfield, New Jersey.

Claim.—"The construction of a pad with a knobbed or noduled face, so that it shall press upon several distinct points or intervals around and upon the tissues concerned in hernia, and not have a continuous bearing."

178. For an *Improvement in Scissors Sharpener;* Wm. E. Roberts, Orange, Conn.

Claim.—"The article of new manufacture of scissors sharpener."

179. For an *Improvement in Coffee Roasters;* Elias Schneider and A. Kolman, New Tripoli, Pennsylvania.

Claim.—"The combination of the agitator with the vertical cylinder containing it."

180. For an *Improved Machine for Multiplying Numbers;* James D. Smith, Brantingham, New York.

Claim.—"The combination of the rotating disk and stationary index or bar, graduated and numbered."

181. For an *Arrangement of Cylinders and their connexions for Locomotive Engines;* Aaron Smethurst, Philadelphia, Pennsylvania.

Claim.—"The arrangement of the two double piston cylinders with their connecting means, in relation to the frame of the engine."

182. For an *Improvement in Candle Snuffers;* O. W. Stow and Augustus Barnes, Southington, Connecticut.

Claim.—"The snuffers, struck out of sheet metal, the legs formed with, and constituting a portion of, the wing blanks, and the cutter wing, bent so as to form a good cutting edge."

183. For an *Improvement in Cultivators;* Joseph Summers, Raleigh, Virginia.

Claim.—"The use of the hinged wings, which are adjusted by rack and pinion, when arranged to move in and out over a stationary curved supporting and guide rod, which

has two springs coiled around it, in combination with a stationary circular notched plate, pivoted tilting lever, and spring."

184. For an *Improvement in Railroad Brakes;* Alfred F. Toulmin, Ellicott's Mills, Maryland.

Claim.—"The self-adjusting or self-regulating action of disengaging the revolving spring axle, about which the brake chair is wound up, from farther contact with the motive or winding power, so soon as the brakes are put down sufficiently to offer a great resistance to the progress of the cars, but before the breaking point of the brake chain is reached; this disengaging being effected by means of the tension from the combination and connexion of a revolving spring axle on one end of the brake chain, and at the other end, the resistance offered to the brakes by the revolution of the car wheels."

185. For an *Improvement in Seed Planters;* L. F. Ward, Marathon, New York.

Claim.—"1st, The covering scrapers, in combination with the pressing rollers. 2d, In combination with the furrowing teeth arranged to traverse perpendicularly, the bar, standard, springs, and locking latch, for raising, lowering, and holding the furrowing teeth in the required position. 3d, The arrangement of the traverse rod, links, and springs, for the purpose of operating the slides."

186. For an *Improvement in Seed Planters;* Caleb B. Winder, North Lewisburg, Ohio.

Claim.—"1st, The inclined planes arranged to catch the seed carried or thrown over by the roller, and deliver it to the roller again, so that it will carry it back to the seed box. 2d, Connecting the draft rod to the beam at the rear of or behind the wheel, in combination with the clevis yoke or staple, which allows it to vibrate."

187. For an *Improvement in Steam Pumping Engines;* John L. Burden, New Haven, Connecticut, Assignor to self and Aaron W. Rockwood, Boston, Mass.

Claim.—"The peculiar apparatus composed of the three pumps, arranged on one common case, and combined with the peculiar steam engine, so as to cause but one three-fold crank necessary to the operation of the three pumps during each entire revolution of the crank."

188. For an *Improvement in Vapor Burning Lamps;* Dexter H. Chamberlain, West Roxbury, Assignor to self and John Borrowscale, Boston, Massachusetts.

Claim.—"The auxiliary chamber or casing, in combination with the tube."

189. For an *Improved Washing Machine;* Thomas A. Dugdale, Assignor to self and George Taylor, Richmond, Indiana.

Claim.—"The combination of the floating disk cords and vibrating tub, with the stationary disk."

190. For an *Improved Washing Machine;* David Elliot, Pembroke, Assignor to self and Isaac White, Merrimack Co., New Hampshire.

Claim.—"A tub or vat with corrugated parallel sides, and a semi-circular or curved bottom, in combination with semi-circular rubbers corrugated on their sides, and arranged to traverse on the axle or on a traversing axle, provided with a spring to draw the rubbers one towards the other, and both towards one side of the vat, for the purpose of washing and squeezing clothes."

191. For an *Improvement in Rotary Chairs;* Jordan L. Mott, Mott Haven, New York, and William Tabele, City of New York, Assignors to The J. L. Mott Iron Works, Mott Haven, New York.

Claim.—"The combination of the securing ring with the flanch projecting from the spindle of the pivot, which is fitted to turn in the socket on the upper end of the pedestal."

192. For an *Improved Machine for Feeding the Flour, Mixing the Materials, and Kneading Dough;* John Hecker and Wm. Hotine, Assignors to John Hecker, City of New York.

Claim.—"The employment of the rotating disk with its slot and cutter or scraper, one or more, in combination with and forming the movable bottom of a vessel containing a supply of flour, to deliver the flour in regular given quantities. Also, in combination with the rotating disk or bottom, the making of the feeder or vessel containing the supply of

flour conical, and with the lower end largest, to prevent the packing of the flour. Also, in combination with the feeder, or its equivalent, and the mixing trough, the inclined revolving plate, for scattering and distributing the flour at or near the periphery of the mixing trough. Also, in combination with the mixing trough and the flour distributor, the revolving channel way along the under side of the distributor for distributing the water or other fluid, and the water at or near the periphery of the mixing trough, to insure the proper admixture of the ingredients. Also, in combination with the flour and water feeders, or their equivalents, the apparatus, or any equivalent therefor, for feeding and supplying the sponge or other leaven, at or near the periphery of the mixing trough. Also, the revolving blades and stationary pins or blades, in combination with a mixing trough having a discharge aperture at or near the centre, and the means for feeding the flour and mixing fluid at or near the periphery of the trough for mixing the ingredients as they are received, and gradually working and kneading them, and forcing them towards the centre where the dough is delivered."

193. For an *Improvement in Preparing Glue Stock;* Obadiah Rich, Cambridge, Mass., Assignor to Peter Cooper, City of New York.

Claim.—"The cleansing of glue stock pieces, and preparing them for the manufacture of glue, by the use of soda or potash. Also, in combination with the above, the use of a mineral acid, for the purpose of effectually removing and neutralizing the alkali in the stock so prepared."

Additional Improvement.

1. For an *Improvement in Inkstands;* Kingston Goddard, Philadelphia, Pennsylvania; patented April 28, 1857; additional dated November 3, 1857.

Claim.—"The straight tube, in combination with a simple cup or receptacle."

Re-Issues.

1. For an *Improvement in Cordage Machinery;* Henry Pearce, Cincinnati, Ohio; patented May 22, 1855; re-issued Nov. 3, 1857.

Claim.—"The method of equalizing the paying out of the strands from the bobbins. Also, the arrangement of a friction or rubbing collar, operated by a plunger, passing upward within the supporting stem and the weighted lever, or equivalent devices, for regulating the degree of elasticity of the rotation of the bobbin spindles."

2. For an *Improvement in the Manufacture of Iron;* William Kelly, Eddyville, Kentucky; patented June 23, 1857; re-issued Nov. 3, 1857.

Claim.—"Blowing blasts of air, either hot or cold, up and through a mass of liquid iron, (the oxygen in the air combining with the carbon in the iron, causing a greatly increased heat and ebullition in the fluid mass,) and decarbonizing and refining said iron without the use of fuel."

3. For an *Improvement in Ploughs;* George Watt, Richmond, Virginia; patented December 9, 1856; re-issued Nov. 10, 1857.

Claim.—"The curved standard with its front or concave side rounded off, and its curved surface extended to intersect the mould-board along its upper edge."

4. For an *Improvement in Diaper Pins;* Joshua Heilmann, Assignor to Ignatius Sturn, City of New York; patented July 21, 1857; re-issued Nov. 10, 1857.

Claim.—"The combination of the sliding curved pin, with the shield or case."

5. For an *Improvement in Seed Planters;* George W. Brown, Galesburg, Illinois; patented May 8, 1855; re-issued Nov. 10, 1857.

Claim.—"In combination with the hinged frames or hinge joint, the locating of the conductor's or driver's seat in rear of the supporting axle, so that as he moves forward or back on his seat, the rear frame may act as a lever for lowering or raising the seeding part of the machine, and thus throw it into or out of the ground as circumstances may require, in turning around or for passing over any obstruction."

6. For an *Improvement in Carding Machines;* Horatio N. Gambrill and Singleton F. Burgee, Woodbury Mills, Maryland; patented February 27, 1855; ante-dated Aug. 22, 1854; re-issued Nov. 17, 1857.

Claim.—"The application of two or more sets or pairs of feeding rollers to the working

cylinder of carding engines; and this we claim whether said feed rollers deliver the material directly on to the main cylinder, or to lickers-in, when said lickers-in are so arranged as to work in connexion with each other, and with the main cylinder. Also, the reversing of the relative velocities of the peripheries of the main working cylinder and stripper at intervals, by an automatic movement, for the purpose of cleaning and preventing the clogging of the main cyllnder."

7. For an *Improvement in Watches;* George P. Reed, Waltham, Massachusetts; patented April 14, 1857; re-issued Nov. 24, 1857.

Claim.—"The arrangement of the barrel in respect to the pillar plate, so that it shall extend through the plate, and be fastened to the dial side of it. Also, arranging the main gear wheel with the retaining power and barrel arbor, so that the said wheel shall serve the purpose of a barrel head, or cover to the barrel. Also, the application of the retaining power directly to the fixed barrel."

8. For an *Improvement in Grain and Grass Harvesters;* Wm. H. Seymour, Assignor to self and Dayton S. Morgan, Brockport, New York; patented December 14, 1852; ante-dated October 25, 1852; re-issued Nov. 24, 1857.

Claim.—"The combination of the platform, the driving gear, the space between the platform and driving gear for the discharge of the gavel, the draft pole, and the stand or rest on the platform for the forker."

9. For an *Improvement in Grain and Grass Harvesters;* Wm. H. Seymour, Assignor to self and Dayton S. Morgan, Brockport, New York; patented December 14, 1852; ante-dated October 25, 1852; re-issued Nov. 24, 1857.

Claim.—"The combination with the stand or rest upon the rear side of the platform, for the person who rakes off the grain, and with the platform, of a strong rail firmly secured to the outer side of the main frame, and extending thence along the rear side of the platform to support it and the stand for the forker."

10. For an *Improvement in Grain and Grass Harvesters;* Wm. H. Seymour, Assignor to self and Dayton S. Morgan, Brockport, New York; patented December 14, 1852; ante-dated October 25, 1852; re-issued Nov. 24, 1857.

Claim.—"The method of protecting the gearing from being injured by the working and twisting of the main frame, by mounting the said gearing in an auxiliary metallic frame firmly attached to the main frame."

Designs.

1. For *Stoves;* Wm. T. Coggeshall, Fall River, Massachusetts; dated Nov. 3, 1857.

2. For *Barometer Cases;* Theodore R. Tinby, Medina, New York; dated Nov. 10, 1857.

3. For *Match Boxes;* Elisha Waters, Troy, New York; dated Nov. 17, 1857.

The claims on the above, are for the several shapes, forms, ornaments, and configurations.

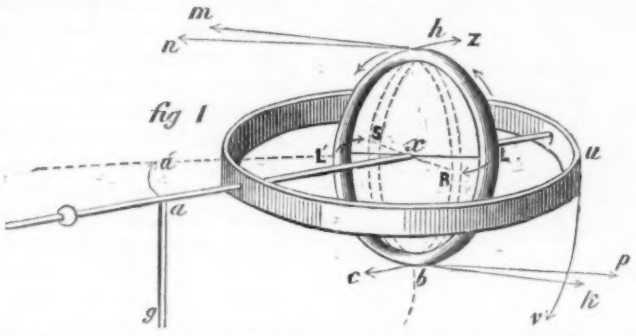
MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

The Gyroscope. By R. Stewart.

The gyroscope, fig. 1, when not balanced, instead of falling, revolves about its support *a g*, in the same direction as the bottom of the revolving wheel moves; but if balanced it will remain stationary. If it is overbalanced, it will revolve as the top of the wheel moves. The revolutions around the support *a g*, are more rapid the more it is overbalanced, and

the longer it revolves. When greatly overbalanced it will at first revolve around *a g* in undulations which gradually cease. The following is intended as an explanation, which the writer does not know to have been hitherto published.



Let *h* L′ *b* L be the wheel, *h* the top, *b* the bottom, *a x* the axis, *a g* the upright on which the axis is placed at *a*. By gravity the wheel will fall towards *g*, revolving about *a* as a centre. But *h a* the distance of the top, equals *b a* the distance of the bottom of the wheel from *a*, and both are greater than *x a*, the distance of the centre of the wheel from *a*. Therefore *h* and *b* being a greater distance than *x* from the centre of revolution, must go faster than *x*. Here, then, are two points, equidistant from an intermediate point *x*, going equally faster than *x*. Therefore, as this is a solid, *h* and *b* will revolve about *x* as a centre, *h* towards *z*, and *b* towards *c*, or the wheel, by gravity, will revolve on its diameter L *x* L′. Let the wheel be now made to revolve on its axis *a x*, in the direction *h* L′ *b* L (shown by arrows); the top of the wheel, or *h*, would go in the direction *h n*, and *b*, as *b p;* in both cases being perpendicular to the direction taken by gravity. Therefore, the wheel will take such a position as shall permit *h* and *b* to go in the direction of the resultants of these forces, or *h* towards *m*, *b* towards *k*. This would be done by the wheel revolving on its diameter *h b*, as an axis, L going forward to R, as shown by the arrow, and L′ backward to s, the axis *x a* at the same time moving to *a*′. But the upright cannot move thus, therefore the wheel moves in the opposite direction *u v*. Or there will thus be a force acting upon the wheel, causing it to move in a horizontal direction around *a g*, in the direction of the bottom of the wheel.

If by any force the wheel be made to go upwards, this horizontal force, and motion also, if nothing prevents, will be in an opposite direction (c), or the wheel and axis will revolve around *a g* as the top of the revolving wheel would go as might be shown by similar reasoning. In what follows, the force causing the wheel to go as *u v*, will be called horizontal force, that which would make it go in an opposite direction, will be called *opposite* horizontal force.

The axis by gravity continues to fall, but by this horizontal force it is turned in a horizontal direction. But by this horizontal motion is developed an upward force which checks its farther descent.

For fig. 2, the wheel revolving around *a g* as *u v*, *x* goes slower than L L′, therefore, L will go as L R, and L′ as L′ s, in opposite directions. But by axial rotation, L goes as L *d*, and L′ s as L′ *e*. The wheel must now take such a position as that L may go as L *f*, and L′ as L′ *t*—the resultants—or *h*, the top, would move forward as arrow *h w*, and *b* backward, as arrow *b y*, and the axis *x a* would fall to *a″*. But this cannot thus move, therefore the wheel will ascend, or the force is now upward. This upward force increasing with the horizontal velocity, finally stops the descent of the axis and wheel, when under their combined influence the wheel ascends till it reaches its former height. In this ascent an *opposite* horizontal force is developed (c), which gradually destroys the first horizontal force (that forward), and gravity destroys the upward. Or fig. 3, *a b* is the perpendicular distance fallen by gravity, *a c d* the direction taken by the horizontal force, at *d* has maximum horizontal force *d e*, and upward *d f*, by which goes to *g*. The horizontal force acquired in falling through the height *a b*, by axial rotation, will be neutralized by the *opposite* horizontal force from the same axial rotation in ascending to the *same* height. The upward force having acquired sufficient intensity to overcome gravity, and prevent the further descent below *b*, will in turn be overcome by gravity in ascending to the same height. The horizontal and upward forces being thus destroyed, gravity again causes the axis to begin to fall to pass through the same changes. In other words, as the pendulum oscillates, so does the axis, only that the oscillations of the axis and wheel are continually forward. Here also the extra weight, resistance of the air, and friction, will affect the motion, and in practice, will prevent the axis from ascending quite to the same height. It was just shown that the *opposite* horizontal force developed in ascending *exactly* to the same height, would just overcome the horizontal force acquired by its fall. If it does not rise to this height it will not be sufficient, and the axis will start on its next undulation with an initial horizontal force, which will prevent its descending to so great a distance before being checked; so that the motion becomes more and more in a horizontal line (H). This, with the diminished axial rotation, will cause the wheel to revolve around its upright *a g*, as if following the thread of a screw or in a spiral.

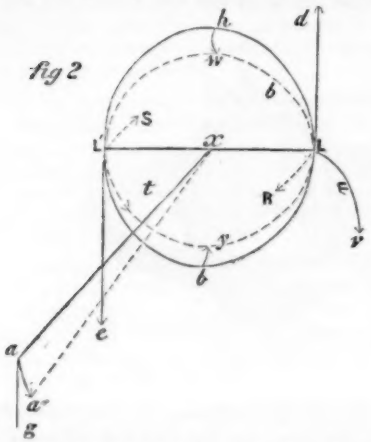


fig 2

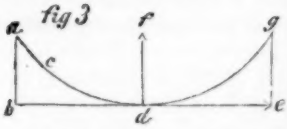


fig 3

As the axial rotation is great in comparison with that from gravity, the change the wheel must make will be slight, that is, the horizontal motion will be slow. For fig. 1, *b p*, represents the axial rotation, *b c* that

from gravity, *b k* will therefore be but little removed or make but a small angle with *b p*, or the wheel will turn but little to permit *b* to take the direction *b k*. Therefore, the swifter the axial revolutions, or the less the force of gravity, the slower will be the horizontal motion, until gravity is nothing, or axial infinitely great, when the axis will be stationary. On the contrary, if the axial is slower, or force of gravity greater, the horizontal will be faster; *i. e.*, the horizontal revolutions will be more rapid as the axial revolutions diminish, and the less will be the angle which the axis makes in falling with the perpendicular *a b*, fig. 3, until the axial ceases, when it is 0°, and the wheel oscillates as the pendulum. The undulations should thus be made more visible, which would be the case, if it were not for (H). This can be shown by starting the revolutions so that gravity may be comparatively great, *i. e.*, by greatly overbalancing the wheel, when the undulations become very plain, though they gradually cease, as explained above.

A Detailed Account of Experiments and Observations upon the Sorghum Saccharatum or Chinese Sugar Cane, made with the view of determining its value as a Sugar Producing Plant, from September 28, to December 20, 1857, at Oakhill, Philadelphia County, Pennsylvania. By JOSEPH S. LOVERING.

The introduction of this plant into the United States, and the hope of producing sugar from it at the North, profitably, have excited such universal interest, that it has this year been planted in almost every State in the Union; and as the season has advanced, the opinions early expressed by many intelligent and scientific experimentalists, that it contains no crystallizable sugar, have apparently been confirmed by later trials. A few crystals, it is true, have been obtained in one or two instances, but all hope of producing sugar from it profitably seems to have been abandoned.

My object in making the following experiments has been to throw what light I could upon this important question, and, in the event of the result proving favorable, to give such a formula as would enable the uninitiated to proceed with confidence of success. They have been pursued without any attempt at extraordinary production, either in the cultivation of the cane or the development of its properties; on the contrary, the experiments were made upon small quantities, under many disadvantages that would not occur in large operations, and consequently with results less favorable.

The series being completed, perhaps the best method of communicating the results and imparting the knowledge obtained, to the public, will be by giving the following extracts from my notes, made as the work proceeded. They will show the progress of the development of the sugar in the stalk, and its decline, with many other interesting facts.

—

Extracts.—On the 10th of May, I planted about half an acre, on upland of good quality, such as would yield in ordinary seasons, 50 to 60 bushels Indian corn to the acre. The rows 4 feet apart, and the plants

intended to be 6 inches apart in the rows, but which, on taking off the crop, proved to be a little over 7 inches apart. When the canes were about 18 inches in height I had the suckers removed. During the month of June I passed the hoe-harrow through it twice, a man following with the hand hoe, as in the case of Indian corn. It was then left to take care of itself. It grew rapidly and evenly, and attained the height of 12 to 14 feet.

My apparatus and utensils for conducting the experiments consisted of the following, viz :

A pair of iron rollers, 7 inches diameter and 12 inches long, set in a frame $\frac{1}{8}$th of an inch apart, with spout to catch and collect the juice, and a crank turned by hand—a few sugar moulds and pots, some ivory black or animal carbon ; two filters, made of common bed ticking, in the shape of an elongated pudding bag—a thermometer, Baumé's Pèse-Sirop or saccharometer, and a polariscope. All the other utensils I obtained from the kitchen, viz: a copper kettle of 10 gallons capacity, a ladle, some tin pans, bowls, buckets, &c., to contain the juice.

—

First Polariscopic Observation.

Sept. 28, Temp. noon, 71° F. Wind S. W., clear.

Of two canes took the first joints above the stay roots—

1st joint, 9 inches long, weiged,	118·854	grammes.
2d " 8 " "	93·742	"
Weight of 1st joints of two canes,	212·596	"
After passing these three times through the rollers, the bagasse weighed,	64·389	"
Leaving, as weight of juice, (69·7 per cent.)	148·216	"
Measured the juice, and found 135 fluid grammes— specific gravity,	1·063	

After precipitation by basic acetate of lead, of a voluminous green colored flocculent substance, it filtered with difficulty, then completed the decolorization by passing it through animal carbon, and found by first observation in polariscope,

A deflexion of the ray, right, 27°		
Add 10 per cent. for dilution by precipitant, 2·7°	29·7 right.	
After inversion by H.Cl. left, 12·0°		
Add 10 per cent., as above, 1·2°	temperature 27°, 13·2 left.	
Sum of inversion,	42·9	

This sum of inversion, (42·9) at temperature 27°, indicates 54·35 grammes of pure dry sugar to the litre of juice, and by reference to past results it is found that 204·24 grammes of sugar per litre, equal 18·82 grammes per 100, or 18·82 per cent. Then, as 204·24 : 18·82 :: 54·35 : 5·008 per cent. of sugar in the juice, and as 100 : 5·008 :: 69·7 : 3·49 per cent. of sugar in the cane. A second observation in polariscope, of the juice from the two joints of the same canes next above these, indicated 5·57 per cent. of sugar in the juice, proving them to be richer than those nearer the ground.

First Practical Experiment.

Sept. 30. Temp. 8 A. M. 40°, M. 66°.

The fact of the presence of crystallizable sugar in the cane being established, I proceeded to cut and grind 20 feet of a row, and passed the 30 canes which it produced, three times through the rollers; about one-fourth of the seed had changed to a dark glistening brown color, but was still milky; the remainder was quite green; ground 6 to 8 of the lower joints, which together yielded $3\frac{1}{2}$ gallons of juice, weighing 9° Baumé; neutralized the free acid by adding milk of lime; clarified with eggs and boiled it down to 240° F.

This first experiment looked discouraging and unpromising at every step; its product was a very dark, thick, viscid mass, apparently a caput mortuum; it stood six days without the sign of a crystal, when it was placed over a flue and kept warm four days longer, when I found a pretty good crop of soft crystals, the whole very similar to the "Melada," obtained from Cuba, but of darker color.

—

Second Experiment.

Oct. 13, Temp. 8 A. M. 50°, M. 72°. S. E. cloudy.

About two weeks having elapsed since the first experiment, the weather in the interim having been quite warm, temperature at 8 A. M. 40° to 52°, and at noon 66° to 75° F.; and about one-half the seed being ripe, I determined to try it again, but not being very sanguine of success, no polariscopic observation was taken.

Cut and ground 50 feet of a row, which produced 88 canes, and yielded 8 gallons of juice, weighing 10° Baumé (one degree more than the previous cutting), from the 6 and 7 lower joints; juice slightly acid. 1st, clarification $4\frac{3}{4}$ gallons, neutralized with 3 table-spoonsful of milk of lime, stirred in 1 lb. fine bone black and 3 eggs, and placed it over a slow fire; at 215° F. took off a very dense, thick, green scum; when at 162° F. it marked $7\frac{1}{2}$° Baumé.

A second parcel of juice from this grinding ($3\frac{1}{4}$ gallons) was treated in the same manner, and set aside, both having been first boiled down to 22° Baumé.

Oct. 14, Temp. 8 A. M. 54°, noon 70°. N. W. clear.

Cut and ground 50 feet; 81 canes, produced $7\frac{1}{4}$ gallons juice, 10° Baumé, which was treated as above, except that the eggs were omitted.

Oct. 15, Temp. 8 A. M. 50°, noon 70°. N. E. heavy rain.

Cut and ground 50 ft, produced $8\frac{1}{4}$ gallons juice, weighing 10° B.

Oct. 16, Temp. 8 A. M. 46°, noon 60°. N. W. stormy.

Cut and ground 50 feet, 86 canes, $8\frac{3}{8}$ gallons, 10° B.

The whole of the foregoing four parcels were at this stage of the process concentrated to 22° Baumé, and set aside until I had completed the series on the 21st October; they were then collected together, and again clarified with eggs, and a second scum taken off; they were then again placed over the fire, and when at the temperature of 225 F., clear lime water in small quantities was added to coagulate the vegetable albumen, which is not disengaged at a lower temperature, but which is

then observed as a whitish scum, very tenacious and glutinous, and is very detrimental to crystallization. After the various delays, heatings, and re-heatings consequent on my limited means of working, (the great disadvantage of which, those acquainted with the subject only can appreciate,) I commenced filtering the whole, but found it so ropy and glutinous that it would not pass through; diluted it to 10° B., when it came through tolerably bright; then passed it through 5 feet of animal black; it parted with its coloring matter very freely.

Oct. 22, Temp. 8 A. M. 32°, noon 50°. S. W. clear.

Divided the product into three parts, and boiled it as follows:

1st part to 230° F.—This stood an hour without crystallizing—found it too low, although the thumb and finger proof indicated otherwise.

2d part to 246° F.—which was added to the first, and in a few minutes crystals began to appear.

3d part to 238°—being the mean of the other two. On finishing this, the two preceding had formed a thick, opaque mass of good crystals.

Filled one mould, wt. 20 lbs.			
Weight of mould,	4¾ "		
		net weight	15¼ lbs.
Filled one mould,	14½ lbs.		
Mould,	4½ "		
		" "	10 lbs.
Total net weight,			25¼ lbs.

and next morning set them on pots to drain. Also boiled down the juice from the tops, 4¾ gallons, which produced with the scums 13¼ lbs. molasses.

Nov. 2, Temp. 8 A. M. 45°, noon 60°. S. W. clear.

Knocked out the proceeds of this experiment, with the following results, viz:

			Sugar.	Molasses.
1 mould, gross weight, 20 lbs.				
tare,	4¾ "	nt. wt. 15¼.		
weight of molasses,		8¼ nt. wt.	7 lbs.	8¼ lbs.
1 " gross weight, 14½ lbs.				
tare,	4½ "	nt. wt. 10 lbs.		
weight of molasses,		5½ nt. wt.	4½ lbs.	5½ lbs.
Add molasses made from the tops, as above,				13¼
Total weight of product of 200 feet of a row, lbs.			11·50	27·25
Fifty rows, 4 feet apart and 218 feet long, constitute an acre, and 200 feet of a row is less than 1-50th part of an acre by 18 feet, therefore add pro rata,			1·03	2·45
Product of 1·50th part of an acre in lbs.,			12·53	29·70
Multiply by			50	50
Product of an acre in lbs.			626·50	1485·00

A gallon of molasses weighs 12 pounds, therefore, divide 1485 by 12, and we have, gallons, 123·75.

For the acre 625½ lbs. sugar, and 123¾ gallons molasses, produced from 18,148 canes, yielding 1737 gallons juice, weighing 9 lbs. per gallon, or 15,633 lbs., being 4 per cent. of sugar and 9·50 per cent. of molasses, or 13·50 per cent. together.

This sugar is of a yellowish brown color, about as dry as, and about the color of, 2d quality Cuba sugar, such as is used by refiners. (See sample No. 2.)

Third Experiment.

Oct. 23, Temp. 8 A. M. 36°, M. 55°. Foggy.

The foregoing favorable progress induced me to make another trial, on a larger scale. The weather looked threatening, and as a precaution, I cut 500 feet of canes and stored it in the barn, to be used in quantities conforming to my means of working.

Nearly a month having elapsed since the first polariscopic observation was taken, and two weeks since the second practical experiment—having had several heavy white frosts, and three nights of ice ⅛ to $\frac{3}{16}$ of an inch in thickness—I concluded to have another examination by polarized light, to see the effect of these changes, when I was gratified to find the following results—juice weighing full 10° Baumé:

First observation, right,	55°		
Add 10 per cent. for dilution,	5·5°		60·5° right.
After inversion,	2°		
Add 10 per cent., as above,	0·2°	temp. 25°	2·2° left.
Sum of inversion,			62·7°

This sum of inversion, (62·7,) at temperature 25°, indicated 79·06 grammes of sugar per litre of juice—then,

As 204·24 : 18·82 :: 79·06 : 7·29 per cent. of sugar in the juice.

		Feet.	Canes.	Galls. juice.	
Oct. 24. Temp. 8 A. M. 54°, noon 60°. Fog and rain.	Ground	100	160	18¾	10° B.
Oct. 26, Temp. 50°-60° Heavy rain.	"	100	159	18½	10° B.
Oct. 27, Temp. 46°-52° Very stormy.	"	100	166	18 1-16	10° B.
Oct. 28, Temp. 40°-52° Cloudy, N.W.	"	100	149	16¾	10° B.
Oct. 29, Temp. 43°-48° Clear, N. E.	"	100	148	14⅞	10° B.

These several parcels were clarified like the second experiment, boiled to 15° and 18° B., and set aside till Nov. 2d, when I found all but the last day's work had changed to a thick, liver-like mass, resembling good

soft soap—very acid and totally ruined. The last parcel, having stood a much shorter time than the rest, was but partially affected. It was boiled to proof, and crystallized very well.

I regret this misfortune less for the trouble it cost me than for the failure of the experiment, for it worked beautifully in the first stages, and the last grinding crystallized freely. The juice weighed heavier than previous or subsequent parcels, and would probably have produced better results. It taught me, however, the danger of delay, and also that no injury had been sustained by the juice so long as the canes remained unground, the last parcel having crystallized perfectly.

—

Fourth Experiment.

Nov. 2. Temp. 38°-50. N. E. clear.

Since the 28th October, the weather has been mild and foggy, with heavy rains; temp. varying from 48° to 60°. A very decidedly increased development of sugar in the juice has been ascertained, viz: 7·29 per cent., instead of 5 per cent., and I have gained some experience; so instead of allowing the syrup to remain from four to twelve days still containing a great portion of its fermentable impurities, gradually undergoing decomposition and depreciation, I remedy this evil to some extent, as will be seen. I also dispense with the fine ivory black and the filtering, thus simplifying the process.

Nov. 2. Temp. 38°-50°. N. E. clear.

Cut and ground 58 feet of a row—100 canes—the upper portions of the stalks turning yellow—leaves dead and dry—ground 6 and 7 of the lower joints—produced 10 gallons juice, weighing 10° B., much less acid than previous samples, and barely changing litmus paper—neutralized with milk of lime, and clarified at once perfectly with eggs—passed it immediately through 3½ feet black, and boiled it to 234° F.; after standing an hour the crystals were large and sharp, but not very abundant till morning, it being boiled too low.

Nov. 4. Temp. 31°-50°. Ice.

Cut and ground 58 feet—100 canes—9$\frac{5}{8}$ gallons—10° Baumé—rather more acid than the last—clarified it fully as above—passed it through 5 feet black, and set it aside, as it is clear and bright, and contains no feculent matter.

Nov. 5. Temp. 34°-62°. S. W.

Cut and ground 58 feet—94 canes—9¾ gallons—10° Baumé—treated as above, and set it aside.

Nov. 6. Temp. 50°-62°. S. cloudy.

Weather changing—cut and ground 58 feet—95 canes—9$\frac{5}{8}$ gallons, 10° B.—treated as above—also ground the tops of all the above 232 feet, which produced four gallons, 2 quarts, and 3 half pints of juice, weighing 12° B.—more acid than the lower joints—treated it the same—boiled it to 238° F. and set it aside. In the morning I found a good crop of crystals, but the mass thick and viscid—added 3 table-spoonfulls clear lime water, heated it to enable me to pour it into a mould—gross weight 9½ lbs., tare 4½ lbs., net 5 lbs. On the 13th knocked it out and had 3 lbs. good brown sugar, and 2 lbs. molasses.

Nov. 7. Temp. 54°-66°. South.

Boiled one-half of the remainder of the proceeds of the above lower joints, (one-third of the whole having been boiled on the 2d, as above stated) to 236° F., and added it to that boiled on the 2d—boiled the other half to 237° F.—potted it at 176° F. very handsomely crystallized, and very light colored.

Nov. 8. Temp. 60°-74°. S. W.

Withdrew the stops and set it on pots to drain.

Nov. 9. Temp. 34°-50°. S. W.

The full mould (15 lbs.size) had run $1\frac{1}{8}$ gallons molasses, or syrup; if it had been boiled a little higher it would have produced more sugar, and less molasses.

Nov. 14. Temp. 30°-42°. N. E. Ice.

The whole having now stood 7 days, and being thoroughly drained, weighed as follows:

1 small mould, 10 lbs.			
Tare,	$4\frac{1}{2}$		
—— net wt. sug.,		$5\frac{1}{2}$ lbs.	
1 larger mould, $18\frac{1}{4}$			
Tare,	7		
—— " "		$11\frac{1}{4}$	
Sugar from the tops, .		3	
Product of 232 feet canes,		19·75 lbs.	
1 pot molasses, 17 lbs., tare 5 lbs., .		.	12 lbs. net.
1 " 9 " 5 .		.	4
1 " $12\frac{1}{4}$ " 5 .		.	7·25
Molasses from the tops, . .		.	2
Product of molasses from 232 feet canes, .			25·25
232 feet are more than one-fiftieth part of an acre by 14 feet, therefore deduct pro rata, .		1·19	1·52
Product of one-fiftieth part of an acre,		18·56	23·73
Multiply by . . .		50	50
Product of an acre in lbs., . .		928·00	1186·50
A gallon of molasses weighs 12 lbs., therefore divide by 12 for gallons, . .			98·87

and we have 928 lbs. sugar (first returns) and 98·87 gallons molasses, made from one acre (18,277) of canes, which produced 1847 gallons juice, weighing at 9 lbs. per gallon, (16,623 lbs.,) or, sugar, first crop, 5·58 per cent., molasses, 7·14 per cent., together, 12·72 per cent.*

This sugar is perfectly dry, as shown by sample No. 4; it worked perfectly, and without the slightest difficulty, at every stage.

Nov. 17. Temp. 34°-48°. N. W.

Boiled all the molasses from the above (except the two lbs. from the tops, which was too poor for re-crystallization) 23·25 lbs., added clear

* Neither the scales in which this juice was weighed, nor the quart measure in which it was measured were sufficiently delicate or accurate to give precise results, and as they form the basis of these calculations, the per centages are probably not absolutely exact, but they are sufficiently so for all practical purposes.

lime water until it marked 35° B. when boiling, took off a thick, glutinous scum, and boiled it down to 243° F., in two hours it produced a copious crop of very good crystals; allowed it to stand till morning, when it was quite solid.

Dec. 18. Temp. 30°-52°. S. E.

Here an unfortunate accident occurred. Having placed the crystallized mass over a slow fire, to render it fluid enough to cast into a mould, I was called off to a case of illness, leaving it over the fire, and being detained much longer than I anticipated, on returning I found all the grain melted and the molasses boiling vehemently, and badly burned. Much discouraged, I however proceeded. It crystallized the second time, and was put into a mould.

December 20.

Weighed the sugar from the 23·25 lbs. molasses boiled on the 17th Nov., as follows, viz:

Gross weight, ...	11 lbs.
Tare, ...	4¼
Second crop of crystals from the 23·25 lbs. molasses, .	6·25 lbs.
Deduct pro rata for the 14 ft. excess over one-fiftieth of an acre,	·373
Second returns from one-fiftieth of an acre, .	5·877
Multiply by	50
Product of an acre from the molasses, . .	293·850

Then we have, as the whole final result of an acre of canes,

	Sugar.	Molasses.
1st returns, . .	928 lbs.	1186·50 lbs.
2d " (Sample IV.) .	293·85	
And deduct molasses converted,		293·85
	1221·85	892·65
And 12 lbs. molasses per gallon gives, .		74·39 gals.

Say sugar, per acre, 1221·85 lbs.; molasses, per acre, 74·39 gallons; sugar, per cent., 7·35;* molasses, per cent., 5·37; sugar and molasses, 12·72 per cent.

I will repeat here, that owing to the accident before stated, this sugar, (Sample No. IV,) 2d returns, is not nearly of so good quality as it otherwise would have been.

Fifth Experiment.

November 9.

I must now mention that the last experiment was intended to have been on a considerably larger scale than those previous. Each day's work was, however, kept distinct and separate from the others, thus enabling me to determine it at any point.

*It may, perhaps, appear inconsistent to the casual observer, to find 7·35 per cent. of sugar obtained, when the juice only contained 7·29 per cent., as shown by the polariscope. This is readily explained. 1st. By the causes stated in a previous note; and 2d, the polariscope indicates pure sugar; whereas the sugar produced contains about 4 per cent. free moisture, and about 3 per cent. of molasses adhering to the crystals, also gum, &c., which would account for much more than the apparent excess.

Having thus proceeded to, and finished the clarification of the 4th parcel, (Nov. 8th,) and the weather becoming and continuing very warm, (thermo. as high as 74°,) I observed a very sudden and unfavorable change in the working of the juice. Instead of clarifying perfectly and with great facility, as at first, the defecation was difficult, the color many shades darker, the juice gradually fell off in weight from full 10° B. to 9° B., and required 10 feet of granulated black to bring it to the same color as that made six days previously with 5 feet black. I however proceeded (keeping this separate) to the crystallization.

Boiled it to 242° F., when it produced good, hard, sharp crystals; but finding the quantity, by measurement, had decreased very considerably, I took no further note on that head, but gave it white liquor until it was neat, (about the usual quantity,) and produced the sugar, (sample No. 5,) being white sugar, directly from the cane, without refining or re-melting.

Sixth Experiment.

November 27.

Since the canes for the fourth and most successful experiment were cut, on the 6th inst., the weather has been very changeable. We have had warm Indian summer weather, with heavy rains, also very cold weather, making ice two inches in thickness; thermometer having varied from 16° to 60°. To try the effect of these changes, I cut $\frac{1}{100}$ part of an acre, which produced $11\frac{3}{8}$ gallons of juice only, instead of 19 or 20 gallons, as before. It had, however, regained its former weight of full 10° B., but was much more acid, rank and dark colored than previously. It clarified without difficulty, but raised a much thicker and denser scum, and, when concentrated, was very dark and molasses-like; it, however, produced good, hard, sharp crystals, but the quantity being much reduced, there was no inducement to pursue it further. This experiment proves, however, that this cane will withstand very great vicissitudes of weather, without the entire destruction of its saccharine properties.

Seventh Experiment.

Took the proceeds of the experiments that were considered failures, viz: all the 3d and the poorest portion of the 2d, viz: 34 lbs. very indifferent sugar—refined it in the open kettle, by the old process, and produced 15 lbs. loaf sugar, (sample No. 7,) which is a very full yield for the quality used.

The foregoing are all actual results produced by myself, (the polariscopic observations having been taken on the spot, under the supervision of my partner, Mr. William Morris Davis,) with no object in view but the truth, and a desire to contribute whatever useful information I could towards the solution of this interesting and important question. They are, I think, sufficiently flattering in themselves to warrant renewed exertions on the part of our agriculturists of the Northern and Middle States

especially, and perhaps those of the South also, in the pursuit of this promising branch of industry, to the full and profitable development of which it is certainly capable, and which it is destined ultimately to attain —(as before mentioned they have been accomplished without the advantages of the powerful sugar mill—the vacuum pan and the many other improved implements and apparatus now in general use in Louisiana and elsewhere,) and they are also important and interesting in many respects, not apparent to those unacquainted with the subject; it may therefore not be superfluous to make some further explanatory remarks:

1st. The mill used and the power employed in these experiments were much less efficient than those in general use on sugar plantations, and the waste proportionally greater, the loss from which causes I estimate at not less than 10 per cent.

2d. It is well known to all who are acquainted with sugar and saccharine solutions, that by frequent heatings and coolings, a considerable portion of the crystallizable, is converted into uncrystallizable sugar, and is consequently lost as sugar—in these experiments every parcel was from necessity heated and re-heated from 8 to 12 different times.

3d. It is impossible to produce as good results, whether as regards quantity or quality, from small, as from large quantities.

4th. This sugar (sample No. 4) is quite dry, and will lose comparatively nothing by drainage; the yield would be considerably greater, if it contained the usual quantity of footing that is contained in the hogshead when sold at the plantation—one of which being weighed there and re-weighed in Philadelphia, in the month of July, will be found to have lost by drainage from 100 to 150 lbs., or from 10 to 15 per cent.

Assuming these propositions to be true, I make the following estimate of the probable yield of an acre of canes of ordinary growth, such as I have experimented upon, viz:

Actual yield as per Experiment No. 4,		1221·85 lbs. sugar, 74·39 molasses.
Add for insufficiency of mill,	10 p. c.	
For heating and re-heating, &c.,	5	
For footings, say but*	5	
	20 p. c.	244·37
Probable yield per acre,		lbs., 1466·22 sug., galls. 74·39 molasses.

Further, it will be observed that my acre produced but 1847 gallons of juice—I have, however, seen published accounts of far greater yield than this, one for instance in this county, apparently well authenticated, reaching 6800 gallons per acre, which, according to my *actual* results, would produce 4499 lbs. of sugar, and 274 gallons molasses, and according to the foregoing *probable* results, would yield 5389 lbs. sugar, and 274 gallons to the acre. I do not pronounce such yield of juice impossible, but it will certainly be of rare occurrence, a mean between this and my yield would be a large return.

Another subject worthy of notice, is the nature of the season. My

*The two latter gains in sugar would be made at the expense of the molasses, taking from it the gain which would be realized by the use of a better mill, and therefore leaving the quantity of molasses unchanged.

impression is, that owing to the lateness and coldness of the spring, and the continued wet weather, the last has been quite an unfavorable season for the ripening and development of the sugar in the juice, to which cause I think a deficiency in the yield of at least 10 per cent. may be attributed, which would further increase the quantity to 1612 lbs. of sugar, and 81 $\frac{8}{10}$ gallons molasses, a yield very nearly corresponding with that of the best conducted plantations of Louisiana, as will be seen by the following figures, which I have collated from a minute statement furnished to me by the enterprising proprietor of one of the most complete and costly establishments in that region, (it being furnished with vacuum pans, and all the most approved machinery of latter times, and conducted under his own personal supervision,) of the actual product of one of his plantations of 266 acres, for eight consecutive years. These figures will also furnish useful data for the estimation of the cost of production here, viz:

Aggregate yield of juice from 266 acres for 8 consecutive years,	4,757,700 gallons.
" " sugar,	3,626,425 lbs.
" " molasses,	217,585 gallons.

COMPARISON.

LOUISIANA.		PENNSYLVANIA.	
Yield of juice per acre,	2236 gals.		1847 gals.
Density of juice, [Baumé]	8·44°		10°
Yield of sugar per gal. of juice,	0·76 lbs.		0·66 lbs.
Yield of sugar per acre,	1704 "	Actual,	1221·85 "
		Probable,	1612·00 "
Yield of molasses per acre,	102 gals.	Actual,	74·39 gals.
		Probable,	81·83 "
Wood consumed per acre, 3·87 cords, at $2·50 per cord.			
Coal for engine, 0·41 tons, at $2·50 p. ton			
Labor, per acre, 3·70 days.			

These details have been extended to a much greater length than was at first intended, but perhaps not beyond a useful limit for those interested. To the working farmer they may appear formidable and prolix, but he may, nevertheless, gain some grains of useful knowledge from them to repay for their perusal. The conclusions to be drawn from them will be seen by the following

Synopsis.

1st. That it is obvious that there is a culminating point in the development of the sugar in the cane, which is the best time for sugar making. This point or season I consider to be, when most if not all the seeds are ripe, and after several frosts, say when the temperature falls to 25° or 30° F.

2d. That frost, or even hard freezing, does not injure the juice nor the sugar, but that warm Indian summer weather, after the frost and hard freezing, does injure them very materially, and reduces both quantity and quality.

3d. That if the cane is cut and housed, or shocked in the field when in its most favorable condition, it will probably keep unchanged for a long time.

4th. That when the juice is obtained the process should proceed continuously and without delay.

5th. That the clarification should be as perfect as possible by the time the density reaches 15° Baumé, the syrup having the appearance of good brandy.

6th. That although eggs were used in these small experiments, on account of their convenience, bullock's blood, if to be had, is equally good, and the milk of lime alone will answer the purpose; in the latter case, however, more constant and prolonged skimming will be required to produce a perfect clarification, which is highly important.

7th. That the concentration, or boiling down, after clarification, should be as rapid as possible without scorching; shallow evaporators being the best.

With these conditions secured, it is about as easy to make good sugar from the Chinese cane as to make a pot of good mush, and much easier than to make a kettle of good apple-butter.

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*On Artificial Ultramarine.** By Dr. H. Wilkens.

The author has published some valuable notices on ultramarine. He discusses the researches of Stölzel† on this subject, and says that they give no better explanation of the composition of the color than any preceding treatise; for in the analysis samples of ultramarine were taken as they were furnished by the manufactory, and their constituents determined, no care being taken as to how carefully the preparation had been washed, or as to whether it had been more or less completely desulphurized. But even attention to both these cases does not insure pure ultramarine; for sand and clay and their impurities are taken up by ultramarine in the most varied proportions; so much so, that the product of one manufactory is different from that of others. And even in the same manufactory there may be slight variations in the composition of ultramarine, for the individual layers of clay have not exactly the same composition.

The oxide of iron found in ultramarine arises from the clay used, and is without influence on the formation of the blue color. Ultramarine prepared in porcelain crucibles from materials free from iron, is exactly the same as that containing iron. And as much as 5 per cent. of oxide of iron added to the mass in the form of soluble salt has also no influence on the color. In seeking the actual constituents of ultramarine, the iron, lime, potash, magnesia, sulphuric acid, and chlorine may be left out of consideration as being non-essential.

By treating ultramarine with hydrochloric acid, one part dissolves up, while another remains undissolved. In the solution alumina and soda are found in constant relation, while the amount of insoluble residue varies with each sort. At the same time $\frac{1}{8}$th of the sulphur is given off as sulphuretted hydrogen, and $\frac{7}{8}$ths is separated as sulphur. Of the fol-

* From the Chemical Gazette, No. 463. † Chemical Gazette, vol. xiv. p. 91.

lowing analyses, I. to V., were of ultramarines from Wilkens's manufactory, and VI. to IX. of samples from other sources.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
$Si\,O^3$	36·74	31·14	36·15	36·31	35·77	31·89	35·73	34·27	31·68
$Al^2\,O^3$	23·97	20·80	23·25	24·81	23·75	20·59	24·95	23·68	21·03
S	12·08	10·59	11 93	11·46	12·77	9·05	12·84	10·61	10·63
Na O	18·15	17·04	18·61	20·27	19·53	17·57	19·23	18·73	18·29
$Fe\,O^3$	1·49	1·32	1·50	1·03	2·28	1·80	2·52	3·00	1·62
$Fe^2\,O^3$	1·07	1·26	0·75	0·91	0·90	3·21	0·69	0·70	0·68
Ca O	1·17	9·73	0·39	0·50	0·37	0·30	0·77	0·35	0·23
Residue,	4·73	17·57	6·13	3·82	2·84	15·23	3·83	8·91	14·56
	99·40	100·45	98·71	99·11	98·21	99·64	100·56	100·25	98·72

If the silica, alumina, sulphur, and soda are calculated for 100, we have—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
$Si\,O^3$	40·25	39·39	40·19	39·10	38·95	40·31	38·52	39·24	38·81
$Al^2\,O^3$	26·62	26·40	25·85	26·72	25·87	26·03	26·90	27·12	25·76
S.	13·42	12·69	13·27	12·35	13·91	11·45	13·85	12·15	13·02
Na O	19·89	21·52	20·69	21·83	21·27	22·21	20·73	21·45	22·41

Wilkens gives to pure blue ultramarine the formula

$$2(Al^2O^3, SiO^3) + Al^2O^3, 3SiO^3 + NaO, S^2O^2 + 3NaS,$$

which would require

SiO^3, ...	38·75
Al^2O^3, ...	26·37
S, ...	13.68
NaO, ...	21·20

Wilkens considers that the blue coloring principle in ultramarine consists of hyposulphite of soda and sulphide of sodium. By treating ultramarine with hydrochloric acid, the hyposulphurous acid is decomposed into sulphur and sulphurous acid, and the latter acting on a portion of the sulphuretted hydrogen arising from the sulphide of sodium, sets more sulphur free.

$$NaO, S^2O^2 + 3NaS + 4ClH = 4NaCl + S + SO^2 + 3HS + HO$$
$$= 4NaCl + 4S + HS + 3HO.$$

In preparing ultramarine from clay, sulphate of soda, and charcoal, a slight access of air is necessary for the production of the blue color; according to Wilkens's view, this access of air causes a partial transformation of sulphide of sodium into hyposulphite. When greater access of air is permitted, another portion of the sulphide of sodium which is necessary for the constitution of ultramarine is oxidized, and hence its color and composition are altered. When sulphur is added to the ultramarine before ignition, it can be heated with complete access of air, for the burning sulphur unites as sulphurous acid with the access of sulphur to form hyposulphurous acid, and preserves the sulphide of sodium from further decomposition.

Breunlin was of opinion that the sulphur in both green and blue ultramarine was in the form of polysulphide of sodium, and not in that of hyposulphite of soda, for the latter salt decomposes into sulphur and a sulphate at the temperature at which ultramarine is formed. To this Wilkens answers, that green ultramarine mixed with sulphur only requires a temperature a few degrees above the boiling-point of water to pass into blue. At this temperature hyposulphurous acid is formed, and not decomposed.

When ignited with saltpetre blue ultramarine first becomes green, which Wilkens explains by the assumption that the hyposulphite of soda is sooner oxidized than sulphide of sodium, which latter is the coloring principle of green ultramarine. Charcoal effects the same transformation of blue with green ultramarine at a red heat; in this case the hyposulphite is reduced to sulphide. When green ultramarine is heated in the air, it passes into blue even without the addition of sulphur. Breunlin thought that in this case a part of the silica of the silicate abstracted sodium from the bisulphide of sodium, which became converted into pentasulphide of sodium. Wilkens remarks on this, that the change takes place at so low a temperature that silica could not be set free, and hence an action on the sulphide of sodium could scarcely take place. If pentasulphide were the condition of the formation of blue color, green ultramarine would be converted into blue without access of air, which is however not the case. Hence the oxygen of the atmosphere plays an important and active part in the formation of the blue color.—*Liebig's Annalen*, xcix. p. 21.

To the Editor of the Journal of the Franklin Institute.

On the loss of Lead and Silver Ores in Washing. By Erskine Hazard.

In an extract from the *Comptes Rendus de l'Academie des Sciences*, on page 61 of your present volume, a loss of lead and silver ore is said to arise from the difficulty of wetting the powder by pouring water upon it, and it floats off. In mixing a dose of magnesia, if you merely throw it upon the surface of the water, it very soon sinks of itself, and is quite smooth; whereas it is very difficult to prevent its being lumpy, if you reverse the process by pouring water upon the magnesia. Perhaps this method would be an improvement in the treatment of the powdered ores.

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*Metallic Alloy for the Formation of Medals, small Figures, &c.**

By M. von Bibra.

Six parts of bismuth, 3 parts of tin, and 13 parts of lead are fused together first of all in a crucible or iron ladle: the mixture is poured out and fused again, if it is to be employed in casting. It is almost as readily fusible as the well-known Rose's metal, but besides possessing considerable hardness, it has the particular advantage of not being brittle, because it possesses no crystalline structure upon the fracture. If the cast objects be bitten with dilute nitric acid, washed with water, and

* From the Chemical Gazette, No. 463.

rubbed with a woolen rag, the elevated spots become bright, whilst the sunken portions are dull, and the casting acquires a dark grey appearance with an antique lustre. Without biting the color is light grey. Some casts of medals taken with this alloy in plaster of Paris were so successful, that the finest contours and the legend, which in the original was only legible with the lens, were completely reproduced. Calculated for 100 parts, this alloy consists of 27·27 bismuth, 59·09 lead, and 13·64 tin. As bismuth is expensive in comparison both with lead and tin, the quantity of lead might be increased and that of the bismuth diminished without injury to the valuable properties of the alloy. It is probable this mixture may be adapted for typographical purposes.—*Polytechn. Centralbl.*, 1857, p. 888.

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*Electric Light.**

Mr. Charles W. Harrison, of Woolwich, has patented some improvements in the production of the electric light. He places pieces of metal, or other suitable material, in gas retorts, or in tubes connected therewith, for the purpose of receiving a deposit of gas carbon, until they are coated to the desired thickness, and he then cuts or grinds them to the required form of electrodes; or, secondly, he uses electrodes of spongy or powdered metals, prepared by compression into any desired shape. He produces lights of various colors, according to the metals used. For the positive electrode he employs a circular disk, which is kept in position by a small roller.

* From the London Builder, No. 768.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 21, 1858.

John C. Cresson, President, in the chair.

John Agnew, Vice-President,
John F. Frazer, Treasurer,
Isaac B. Garrigues, Recording Secretary, } Present.

The minutes of the last meeting were read and approved.

A letter was read from the Regents of the University of the State of New York.

Donations to the Library were received from the Royal Astronomical Society, the Statistical Society and the Society of Arts, London, and the Royal Cornwall Polytechnic Society, Falmouth, England; L. A. Huguet Latour, Montreal, Canada; Prof. A. D. Bache, Coast Survey, Washington, D. C.; Wiley & Halsted, New York; the Mechanics' Institute, Nashville, and P. H. Thompson, Columbus, Tennessee; and George W. Conarroe, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement for December, 1857, and his annual statement for the year 1857.

The Board of Managers and Standing Committees reported their minutes.

The Committee on the Library reported their annual statement for the year ending December 31st, 1857.

The Committee on Publications reported their annual statement of the Journal of the Institute for the year ending December 31st, 1857.

Candidates for membership in the Institute, (3,) were proposed, and the candidates proposed at the last meeting (5) were duly elected.

The Tellers of the Annual Election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen duly elected :—

John C. Cresson, President.

John Agnew, Matthias W. Baldwin, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Frederick Fraley, Corresponding Secretary.

John F. Frazer, Treasurer.

MANAGERS.

Samuel V. Merrick,	Isaac S. Williams,	Lawrence Johnson,
Thomas Fletcher,	George W. Conarroe,	George C. Howard,
Abraham Miller,	Thos. J. Weygandt,	William Sellers,
Edwin Greble,	Joseph J. Barras,	James H. Bryson,
David S. Brown,	Joseph Harrison, Jr.,	Frederick Graff,
Thomas S. Stewart,	George Erety,	Ellis S. Archer,
Alan Wood,	Evans Rogers,	Charles Magarge,
John E. Addicks,	Robert Cornelius,	John M. Gries.

AUDITORS.

Samuel Mason, James H. Cresson, Samuel B. Finch.

At a meeting of the Board of Managers, held January 27th, 1858, the following officers were elected for the ensuing year:

George Erety, Chairman.

Isaac S. Williams, James H. Bryson, } Curators.

Mr. Guillou exhibited a plate representing a view of Yorkminster, prepared by the photo-galvanographic process of Prof. Pretsch, of Vienna, described in the last number of the Journal, with several impressions from others prepared by the same process; also a similar plate prepared by Weir & Langenheim, of this city, by an analogous method not yet made public.

Dr. Rand exhibited Auben's patent gas reflector. It consists of nine adjustable mirrors, arranged below and behind the burner, so as to reflect the light in any desired direction. It is cheap and convenient.

W. Jones asked the attention of the members to a specimen of fire-proof flooring proposed to be used upon bridges, or in buildings, by the designer, Mr. T. S. Stewart, C. E. It is composed of plate-iron, corrugated so that in section the corrugations form three sides of a square: the recesses upon the upper side are filled with a cement sufficiently hard to bear the action of wheels. The specimen was sent to be tested upon

the machine of Mr. F. C. Lowthrop, now exhibiting in the Hall of the Institute.

Prof. Fairman Rogers presented to the Institute, in the name of Joseph S. Lovering, Esq., of Philadelphia, some specimens of sugar made from Chinese sugar-cane, (*Sorghum saccharatum*,) grown at Mr. Lovering's country-seat, near Philadelphia. The specimens consisted of white loaf sugar and of sugar taken at different stages of the process. Prof. Rogers made some remarks upon the process of preparing the sugar, and of the yield of the cane, the account of which will be found at length in Mr. Lovering's article in the present number of the Journal.

Some remarks were also made upon the value of the cane as food for cattle, and of the application of the fibres of the plant to the manufacture of paper, for which purpose it is said to be well adapted.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Ellwood Morris's Railroad Splice.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Railroad Splice, invented by Ellwood Morris, Esq., C. E.,

Report:—That they have carefully examined the model and drawing presented by Mr. Morris, of a railroad splice invented by him.

The best method of connecting the bars of a railroad track has long occupied the attention of engineers and mechanics, and it is certain that there is no part of the superstructure of a railroad which is so imperfect.

The continual jarring of all parts of the machinery, caused by the passage of the wheels over the joints of the rails, is the clearly recognised cause of a great part of the injury sustained by the rolling stock; and so far none of the numerous plans proposed have entirely overcome the difficulty.

The use of long bars certainly improves the track, by reducing the number of joints; but there is, of course, a practical limit to this, and the continuous rail, although apparently adapted to overcome the difficulty, has so many practical objections and is so expensive, that it has not come into general use.

In the ordinary method of making rails and chairs, the necessity of making the chairs fully large, so that they will be sure to fit all the rails, which frequently vary very considerably in size, renders it almost impracticable to make a firm joint, the ordinary joint-chair being at any rate too short to have much effect in stiffening the rails. Wedging the rails into the chairs has always been unsatisfactory, from the tendency of the wedges to become loose and to shake out.

Latterly, therefore, both in Europe and this country, attention has been turned to the different methods of fishing or splicing the rail, by the application of long pieces of wood or metal, on one or both sides of the rail, secured by bolts passing through the rail, by holes made elliptical, to permit the expansion of the iron; a method certainly much more effective than any other which has yet been tried.

Until some entirely different method is proposed, the important point

is to devise some form of fish or splice which shall be effective and cheap; cheapness and simplicity being evidently most essential for a fastening, five or six hundred of which are used in each mile of a single track.

Mr. Morris's splice is arranged as follows, claiming only to be a modification of the splice, and not an entirely new fastening:

The joint is made *between* two cross-ties, the ties being eighteen inches apart, from centre to centre. The chair is made of one or two pieces of plate iron 24 inches long, 10 inches wide, and $\frac{1}{2}$ an inch thick, rolled into the form shown in the drawing, embracing the rail up to the underside of the head, and secured by four bolts passing through the rail. (See inventor's description and drawing annexed.)

Other splices or fish-plates depend upon the fitting of the plate to the rail, and the actual pressure caused by the bolts. In this arrangement, a constant and perfect grip of the rail is intended to be obtained by the elasticity of the iron, as shown in the drawing at *g f g f*, this being the important characteristic of this form of splice.

A fish-joint or chair, upon the same principle, was patented in England in 1853, by Charles Heard Wild, (Eng. Pat. Specifications, 1853, No. 651,) but the present form has the advantage in simplicity.

Altogether, although not differing very essentially from Wild's splice, the Committee consider it one of the best forms of iron splice that has yet been proposed, and consider it well worthy of trial.

By order of the Committee,

Philadelphia, Oct. 8th, 1857. WILLIAM HAMILTON, *Actuary.*

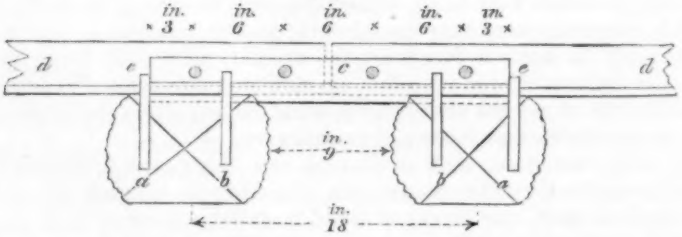
Description by ELLWOOD MORRIS, C. E.

First Plan, in a single piece.

This plan was exemplified in the connected pieces of railway bar shown at the Exhibition, (November, 1856,) and submitted to the Committee; and it may also be explained with reference to the annexed sketches.

Fig. 1, *e e* represents a side view of the splice, notched down its own thickness $\frac{1}{2}$-inch into both the joint sills. The joint is made *between* the sills, which are to be spaced 18 inches apart centres; and this joint at *c*.

Fig. 1.

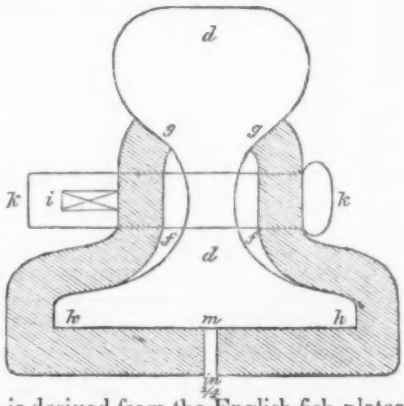


is intended to be left $\frac{1}{4}$-inch open, to allow for expansion and beating out; the splice is secured by *four* $\frac{5}{8}$-inch key-bolts, as shown in the

sketches. The spliced rails are to be secured to the joint sills, by the usual hook-headed spikes, *a a b b*, the spikes *a a* being driven behind the ends of the splice, so as to prevent endwise motion; *d d* represents the usual edge rail. The sills are to be supported on ballast as usual.

Fig. 2 represents a cross section (*half size*) of the splice, grasping the rail; *d d* the usual edge rail; *k k* the $\frac{3}{8}$ths inch key-bolts. These bolts are to fit tight in the sides of the splice, but the holes for them in the rails are to be slotted $\frac{1}{16}$ inch each, to allow for expansion and contraction; *i*, is the split key, $\frac{3}{8}$-inch × $\frac{1}{4}$-inch, which confines the splice and rails together; *g h* are the points, where the splice firmly grasps the rail, by the action of the key-bolts; and in consequence of the open spaces *f f*, left purposely, the splice grips the rails with *a spring tension*, which is necessary to durability.

Fig. 2.



Remarks. It will be observed that the general idea of this splice is derived from the English fish-plates, which have of late been so very successful in securing the joints of railways. I propose 4 bolts, because that number is the least that will prevent absolutely any vertical motion at the joint, unless the bolts break. Somewhat similar splices, with two bolts, have been proposed; one quite similar is sketched in an English publication, printed *since* this splice of mine was *exhibited* by the Franklin Institute. This splice is turned up into the shape of the section, fig. 2, out of a flat plate 24 inches long, 10 inches wide, and $\frac{1}{2}$-inch thick, when used in a single piece, or of $24 \times 4\frac{7}{8} \times \frac{1}{2}$ by two in number, when used as *a two part splice*, as below.

Second Plan, in two pieces.

Owing to the difficulty of making this splice in a single piece, I propose generally to use a modification of the splice above submitted, by simply dividing it into *two halves*, by the slot *m*, fig. 2, which I propose to leave about $\frac{1}{4}$-inch open, throughout the length of the splice, *dividing it into two separate pieces*, a quarter of an inch or more apart, when in use. In this form, in *two* pieces, there will be no difficulty whatever in rolling the iron for the splice in long lengths, and sawing it when hot, into pieces of 2 feet in length, by the usual plan adopted in rolling-mills.

Even if used in *one piece*, it is believed this splice can be made by means of a modification of the machinery now in use, for making wrought iron railroad chairs, *but the two part splice is the one preferred*, as, without loss of effect, it accommodates itself to the irregularities of the rail-bars in a way that no single chair or splice could do. The weight of this splice and its bolts complete, will be about 38 pounds, and the cost of each joint spliced in this manner will be *two dollars*.

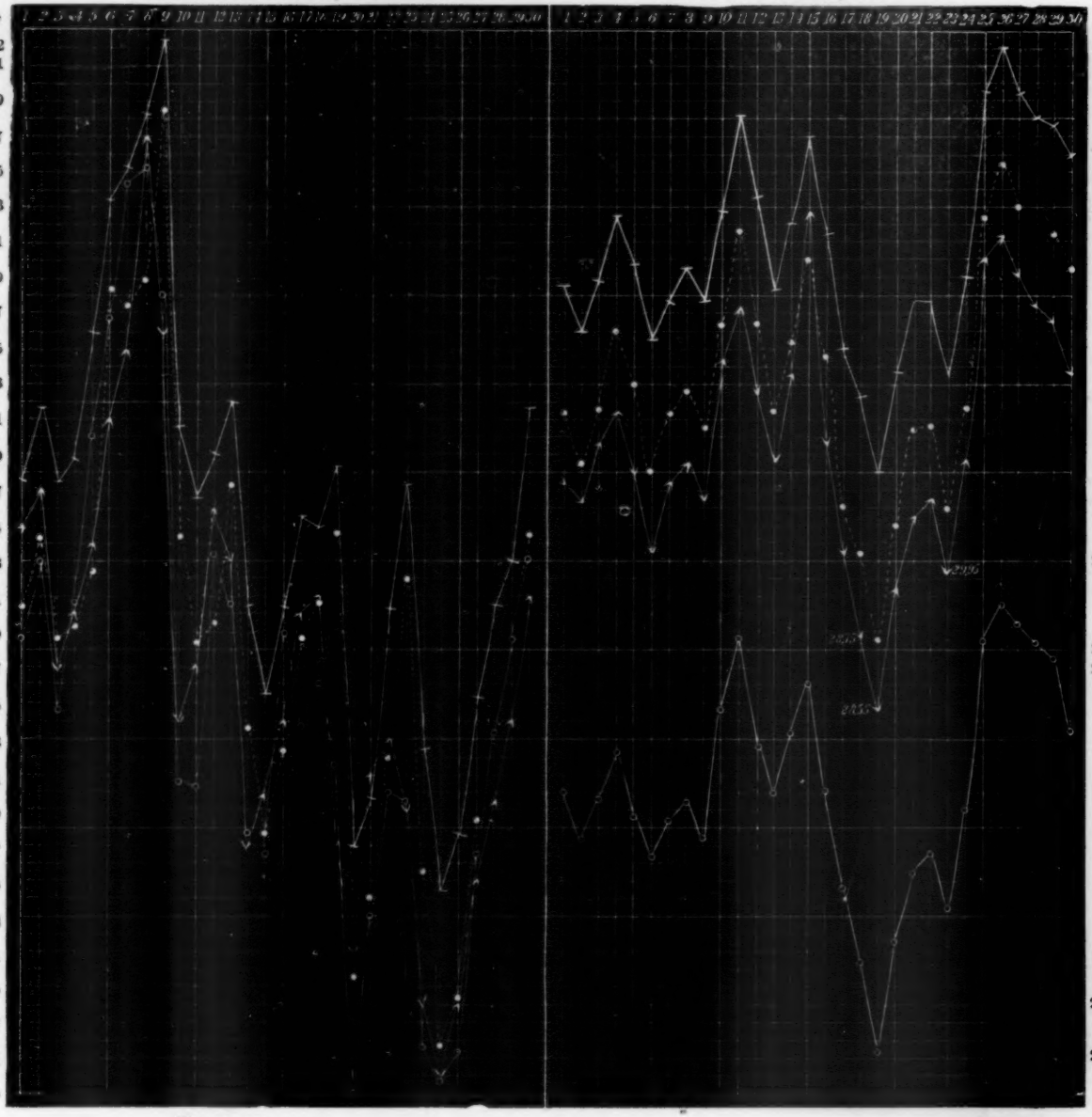
Abstract of Meteorological Observations for November, 1857; made in Philadelphia, Northampton, Somerset, and Huntingdon Counties, Pennsylvania, for the Committee on Meteorology of the Franklin Institute.

November, 1857.	PHILADELPHIA.—Lat. 39° 57′ 28″ N. Long. 75° 10′ 28″ W. Height above the sea 50 feet. Prof. J. A. KIRKPATRICK, Observer.									EASTON, Northampton Co.—Lat. 40° 43′ N. Lon. 75° 16 W. Height above the sea about 340 feet. SELDEN J. COFFIN, Observer.						SOMERSET, Somerset Co.—Lat. 40° N., Lon. 79° 3′ W. Height about 2750 ft. GEO. MOWRY, Observer.				HUNTINGDON, Huntingdon County. JACOB MILLER, Obsr.		
	Barometer.		Thermometer.			Relative humidity. 2 P. M.	Force of vapor. 2 P.M.	Rain.	Prevail'g winds.	Bar.	Ther.	Relative humidity. 2 P.M.	Force of vapor. 2 P.M.	Rain.	Prevail'g winds.	Bar.	Ther.	Rain.	Prevail'g winds.	Ther.	Rain.	Prevail'g winds.
	Mean.	Mean daily range.	Mean.	Daily oscillation	Mean daily range.					Mean.	Mean.					Mean.	Mean.			Mean.		
	Inch.	Inch.	°	°	°	Per.ct.	Inch	Inches.		Inch.	°	p. c.	Inch.	Inch.		Inch.	°	Inches.		°	Inch.	
1	29·784	·027	47·7	18	3·3	40	·179		WNW	29·427	40·2	59	·139		W.	27·604	38·7		WSW.	45·0		W.
2	29·654	·129	51·8	19	4·2	40	·215		S W.	29·270	44·3	34	·155		(var.)	27·462	43·0		W.	47·0		S W.
3	29·797	·143	47·5	16	4·3	43	·180		N W.	29·437	38·7	43	·143		(var.)	27·635	34·7		W.	37·5		N W.
4	29·972	·175	48·7	20	2·2	41	·191		S W.	29·640	39·4	52	·172		(var.)	27·713	40·7		S.	40·0		S.
5	29·843	·136	56·0	23	7·3	59	·375	0·106	S E.	29·503	42·3	81	·356	0·11	(var.)	27·544	51·0	0·127	S.	44·5	0·350	W.
6	29·630	·213	63·3	11	7·3	74	·509	0·005	S.S.W.	29·250	58·5	76	·461	0·01	(var.)	27·425	56 7	0·233	S.	51·5	0·087	S.
7	29·738	·108	65·2	16	2·2	56	·448		W.	29·420	57·3	36	·220		S E.	27·511	64·3		(var.)	55·0		S.
8	29·812	·073	68·2	18	3 0	98	·832		S. E.	29·497	59·0	93	·512		S E.	27·564	65·3	0·253	S.	67·0	0·626	S.
9	29·736	·075	72·3	10	4·8	64	·600	0·316	S S E.	29·397	68·2	68	·554		S.	27·479	58·0	0·590	S.	56·0	2·185	(var.)
10	29·998	·262	51 7	24	20·7	33	·143		N W.	29·663	44·5	59	·195	0·25	N W.	27·847	39·7		(var.)	34·5		N.
11	30·253	·255	46 8	20	6·2	39	·167		N W.	29·937	38·5	45	·157		N W.	28·027	30·3		W.	37·0		W.
12	30·033	·220	49·0	19	2·2	41	·191		S W.	29·687	39·7	41	·159		(var.)	27·746	43·3		(var.)	46 0		S.
13	29·762	·271	53·0	10	4·0	63	·295	0·005	S W.	28·410	47·2	49	·206	0·03	W.	27·600	40·7	0·090	W.	43·0		W.
14	29·954	·192	40·5	10	12·5	64	·183		N W.	29·637	33·8	46	·110		N W.	27·764	27 7	0 005	W.	27·0		N.
15	30·207	·253	35·5	17	5 0	38	·102		N W.	29·857	27·8	37	·085	0·02	(var.)	27·906	26·7		S S E.	30·0		N.
16	29·924	·283	40·3	15	4·8	75	·218	0·730	S E.	29·580	32·2	90	·191	0·35	S E.	27·605	39·0	0·257	(var.)	34·0	0·276	E.
17	29·570	·354	45·7	12	7 7	54	·219		N W.	29·150	38·7	67	·186		W.	27·342	33·7	0·021	W.	40·0		W.
18	29·467	·103	45·9	16	3·7	72	·270		(var.)	29·027	40·7	61	·182	0·07	(var.)	27·124	36·0	0·050	W.	41·0	0·030	N W.
19	29 255	·212	48·3	23	8·7	50	·268	0·156	(var.)	28·770	44·5	49	·223	0·16	(var.)	26·922	31·7	0·074	S W.	27·0		S.
20	29·534	·279	27·0	9	21·3	46	·077		W	29·103	19·5	47	·055		W.	27·199	13·0		W.	21.0		W.
21	29 749	·214	29·8	15	6·5	70	·142	0·015	WSW.	29·373	24·0	44	·070	0·05	S W.	27·374	23·0	0·036	S W.	31.5		(var.)
22	29·743	·023	41·3	19	11·5	38	·139	0·229	S W.	29·380	32·0	50	·138		(var.)	27·424	30·0		WSW.	33 0		W.
23	29·536	·210	47·2	18	5·8	74	·321		S E.	29·153	42·0	79	·296	0·22	(var.)	27·262	29 7	0 147	WSW.	29·0	0·280	W.
24	29·802	·271	32·2	17	15·0	61	·129		var.)	29·443	25·5	49	·079		W.	27·556	15·7		W.	18·5		W.
25	30 311	·511	24·3	7	7·8	39	·055		N W.	29·973	15·7	38	·045		N W.	28 017	13·7		(var.)	14·0		(var.)
26	30·456	·146	26·8	17	5·2	55	·101		WNW	30·123	18·5	43	·068		N.	28 132	15·3		WSW.	18·5		W.
27	30·328	·129	35 3	23	8·5	26	·081		S W.	30·009	28·3	29	·075		(var.)	28·066	26·7		WSW.	25·0		W.
28	30·258	·070	40 5	22	5·2	57	·142		(var.)						N.	28·026	33·3		WSW.	29·5		W.
29	30·230	·034	43·0	23	2·5	52	·133	0·013	WSW.	29·023					E.	27·937	38·7		S.	34·0		W.
30	30·159	·071	51·8	20	8·8	63	·295		E.	29·827	44·8	91	·307	0·21	S E.	27·782	43·0	0·499	S.	41.0	0 643	S.
Means	29·883	·181	45·9	17	7·1	53	·240	1·575	s 66°w.	29·521	38·3	55	·198	1·48		27·620	35·8	2·382			4·477	

Comparison of the Thermometric and Barometric Means of Philada., Northampton, Somerset, and Huntingdon Counties.

Thermometer for November, 1857.

Barometer for November, 1857.



EXPLANATION.—

Those marked o—o Somerset County. Those marked +—+ Philadelphia County.

" '—' —Northampton " " <—> Huntingdon "